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EDITORIAL NOTES—GAS, &c.

Broadening the Basis of the Central Organization.

IT has got abroad, in more ways than one, that the Committee to whom was referred the consideration of the question of the broadening of the basis of the membership of the Institution of Gas Engineers have determined to report in favour of an abandonment of the idea, until it is seen how far the British Commercial Gas Association meets the requirement for bringing the greater number of those, administratively or executively, responsible for the interests of the gas industry into closer relationship with the central organization. We put the matter of the decision thus broadly, pending an opportunity for the Committee to report upon it. When they have disclosed their views, then will be the time to discuss the decision. The subject of the need for an enlargement of the basis of the Institution was discussed by Mr. James W. Helps in his presidential address in 1910, and in our editorial columns on July 20, 1909. Now we are at the close of December, 1911; so we may expect that a serious and well-reasoned report on the subject will, in due season, be received.

Meanwhile, mention has been made in our columns that the Institution of Electrical Engineers are considering the question of the revision of their rules—among the objects being the broadening of the basis of the Institution. This is extremely interesting, having in view the breadth of the basis of the composition of their membership, the units of which aggregate more than 6000. There was a little discussion of this figure and of the total of the membership of the Institution of Gas Engineers last week in the article, headed "The Daily Press and the Gas Industry." In view of the considerable membership of the Institution of Electrical Engineers, the grounds on which it is proposed to extend it are naturally sought. They are briefly and explicitly described in an address delivered by the President of the Institution (Mr. S. Z. de Ferranti) at a meeting of the Scottish Local Section when the matter was under discussion; there having been a sort of reference to the Local Sections, to learn their views. In the first place, Mr. Ferranti drew attention to the fact that electricity had passed from the stage when it was a novelty; and the industry had now got down to the dry, practical side of the business which was made up of an immense mass of details, which were not nearly so attractive and interesting. Then he proceeded:

> In this change there was a danger of the Institution losing interest and popularity. Along with this development of the business there had grown up multifarious interests, some of them purely technical, some of them commercial, and many of them a combination of the two. These interests were not being properly looked after and superintended; and he thought it was the duty of their Institution to do it. This meant broadening the basis of membership, so as to include the various classes of people represented by these interests. In order to have their profession and industry properly protected and organized, they should be able to include in their membership commercial men with electrical interests, gentlemen in the legal profession who were connected with the industry, and such prominent public men who might have an interest in the industry. If they would agree to the principle of broadening their basis along these lines, the name to be given to the new class could be gone into later. By broadening the basis in this way, the efficiency of the Institution would be greatly increased, and the practical value and use of membership would be largely enhanced. With proper organization, electrical interests of every kind might be thoroughly attended to, and electrical progress definitely promoted. As at present constituted, the Institution was not fit to overtake this work.

We have ventured to quote Mr. Ferranti's remarks at length, because they so completely fit the circumstances of our own industry in relation to our principal central organization. The Institution must look to it that the electrical industry does not get a more effective central organization than the gas industry, and partly because some members of the Institution of Gas Engineers believe that their technical attainments might not in an extended organization be sufficient to enable them to maintain the priority of their official status. The main consideration in the present shelving of the question is, however, said to be the existence of the new British Commercial Gas Association; and a desire to see how far it meets the acknowledged deficiencies of the Institution—not as a technical organization, but as a central organization for the industry. May it not be that the British Commercial Gas Association will in time become the central organization through superior usefulness to the gas industry, and the Institution be gradually forced into a back seat? However, the matter that has prompted this reference to the subject is the serious attention that is being given to expansion of basis by the chief organization of the sister industry.

Amazing Electric Street-Lighting Under-Estimate.

WITH closed doors, the Hampstead Borough Council last Thursday night were considering, to a late hour, an unpleasant Christmas surprise for the ratepayers. So serious were the issues, financial and personal, that the Council passed a resolution excluding from the Council Chamber not only our own representative, but those of the local Press, and members of the public desiring to be present. It was not a very courageous proceeding on the part of a majority of the members of the Council to screen an ugly tale of excess expenditure on the conversion of the street lamps from gas to electricity, and a tale that carries with it an acknowledgment that responsible members of the Council were utterly oblivious of what was going on under their very noses in connection with this particular matter. The excess expenditure involved is no less than £10,000; and the ratepayers ought to press for a thorough inquiry into the question so as to see how it was that work of this importance and magnitude was going on, and money being expended to the extent of 68½ per cent. beyond the estimates submitted by the officials of the Electric Lighting Department, without admittedly proper supervising control. A grave administrative blunder has been committed—perhaps grave administrative negligence would be a better expression; and the ratepayers who are the most interested parties should insist that the matter must not end (as indubitably a majority of the Council would much prefer that it should end) with the infliction of the displeasure of the Council upon the electrical officials involved in a manner that to them, professionally, is extremely grave. The Chief Electrical Engineer (Mr. G. H. Cottam) has been asked to resign, and the immediate termination of the engagement of the Assistant Engineer (Mr. E. Sayer) was resolved upon.

The full tale of this unhappy business was told in a report presented by the Lighting Committee, which included a report of the Business Sub-Committee; and probably the best piece of work that this Business Sub-Committee have ever done in the discharge of their municipal duties, has been the minute investigation they have made into the details of this quite recent revelation of the actual expenditure, compared with the estimated cost, of converting the street-lamps throughout the borough from gas to electric lighting. We do not know whether this Business Sub-Committee is composed of the members who last year advised that the system of electric lighting for the public lamps would be the most advantageous to the public. But whether or not this is the case, now that the change has been effected they, and the Lighting Committee, have had a shock from which it will take some effort for them to recover, and time to efface from their memories. They, with the Council, have been blindly proceeding throughout this business. They, neglecting the true interests of the ratepayers, in favour of the municipal electricity undertaking, discarded several offers by the Gaslight and Coke Company in the spring and summer of last year; and they rejected the warnings of the Company as to the cost of street electric lighting being under-estimated. Now they are face to face with the concrete fact that the estimated cost of £15,072 for the work of conversion of the public lamps from gas to electricity has, in the result, positively amounted to the huge sum of £25,398—£10,326 in excess

of the estimates passed by the Council, or 68·5 per cent.! The excess, it is computed, is equivalent to a rate of 2½d. in the pound, with the rates now standing at 7s. 6d. in the pound. Probably, however, the burden of excess will be a charge against the electric supply undertaking over a series of years.

Small wonder the Sub-Committee are, as we gather, filled with dismay and concern, now that they and the Lighting Committee realize, as they must do, how wholly incompetent they were to form any safe judgment upon the estimates that were presented to them. It is true they took the precaution—but of what real value was it?—to have the lamps in ten roads converted to check the estimates, with the result that they were informed that the actual cost of connecting these lamps was some £10 less than the estimated cost of £798, whereas they now "ascertain" that the "actual" cost presented to them was erroneous and misleading, and that the cost was actually £1146. This merely shows that their competence in matters of the kind did not extend to the technical investigation of details. We are not going to criticize the preparation of the estimates; the dismal truth now before the ratepayers is a sufficiently caustic comment upon this aspect of the question. Another feature of the deplorable business is that between April, 1910, and September, 1911, there is not a month in which items have not been charged to "other expenditure" which were properly chargeable to electric street lighting. The Sub-Committee have made a clean breast of the whole matter to the Lighting Committee, and the Lighting Committee to the Council. And we fear that, if the matter was investigated in many other places, Hampstead would not be found to be the only sinner among municipal electricity trading departments that has similarly acted in covering the actual costs of converting public lamps from gas to electricity. However, with Thursday's meeting of the Hampstead Council, this matter cannot end; for it shows that the financial control in this matter has been of a character that is indefensible.

We believe this was the municipal electric public lighting scheme that, at a meeting of the Gaslight and Coke Company last year, the Governor (Mr. Corbet Woodall) referred to as an illustration in dealing with the question of the unfair treatment of private enterprise in this matter of public lighting, without regard, too, to the interests of the ratepayers, by municipal administrators of electricity supply undertakings. Whether that be so or not, we certainly do remember that, by the instruction of the Directors, the General Manager of the Company (Mr. D. Milne Watson) submitted, when the matter of the lighting of the borough was under discussion, offers and criticisms to the Hampstead Council, and that the Company's Controller of Gas Sales (Mr. F. W. Goodenough) had an interview with the Lighting Committee, at which the financial aspects of the proposed displacement of gas were clearly pointed out. The Company guaranteed that they would give, and proved they could do so, 20 per cent. more light by inverted burners than was being obtained by the then existing gas-burners, and per inverted burner a more effective light than two 35-watt metallic filament lamps. Calculation was also made as to the direct loss that would accrue to ratepayers by adopting the electric light scheme in preference to the Gas Company's offer. In the light of the revelations now made, one of the communications addressed by the Company to the Borough Council has such interest that we reproduce it in our "Miscellaneous News" columns. Inasmuch as merit and sound finance had no part in the settlement of the question in 1910 (any more than they may have had in similar cases in certain other districts of London), perhaps now an investigation will be made to ascertain which is the greater, the profit—if, as is highly doubtful, there be anything but a heavy loss—to the electricity undertaking, or the loss to the ratepayers by the rejection of the Gas Company's final offer.

We will not say more now; but we hope that the lesson of Hampstead will be useful to other Municipal Authorities throughout the country, and assist in preventing them being misled by estimates, and deceived by the transference of charges to items in and among which they have no legitimate claim to be included. At the moment, we are sorry that the ratepayers of Hampstead are face to face with this tale of municipal mismanagement. If the Gaslight Company's tender had been accepted, not a penny piece more than the contract price would have been demanded from the Council. Therein is a big difference between municipal administration and a contract with a privately controlled and enterprising Company. Over the latter, too, the Council would have had control in the matter of the contract; over the Council, the ratepayers have practically no effective control. Will Hampstead now be quoted by electric lighting authorities all over the country as an example to be followed in the matter of street lighting?

Continuous Chemical Control of Gas-Works.

Our columns are more than ordinarily interesting this week in the evidence they afford of how scientifically-trained workers for the industry have been, and are, labouring to assist the gas maker to produce what has become more than ever a requisite, through the new and varied modes of using gas—that is, gas of uniform quality and density, and gas free from an undue percentage of inert gases. A large amount of science may be bestowed upon the attempt to produce constancy in works' methods; but works' methods are so subject to a great number of variable factors that the final arbiter as to their constancy or otherwise must necessarily be the product itself. A careful watch must therefore be kept over the product—not only in the matter of illuminating power (we wish the last had been seen of that), but in the matters of calorific power, specific gravity, carbon dioxide, nitrogen, &c.

Under the ordinary modes of determining the state or quality of the gas in these respects, the works' chemist has to make special tests, and some of them represent a laborious amount of work. Therefore, no gas-works' chemist with his multifarious duties will resent the introduction into his laboratory equipment of continuous automatic assistants that will tend to lighten duties that have, through the changing conditions of gas supply, been gradually creeping up in weight, and demanding closer and closer application. Gas technicians have learnt that there is economy in the chemical control of their works' methods, and that there is satisfaction in a uniform product with as little deleterious constituent as possible. Thus the growth of work that has come upon the shoulders of the chemist and on his department. But all works cannot afford chemists; and all works' engineers and managers cannot afford to devote their time to a constant chemical supervision of their production. Yet it is just as necessary to their commercial success, in face of the more strenuous competition to-day, that their primary product should be kept at a constant qualitative pitch as in the case of the larger and more affluent works.

But how is this to be accomplished? How is time to be saved? How are accurate indications to be secured without lavish expenditure of time? The answer is by the utilization of automatic and continuous control by the ingenious apparatus that has been devised by clever brains, and that have a proved dependability that justifies their application with a large measure of confidence. Men who live in a special line of work, devoting their specialized and trained minds to devising new methods for current and new requirement, are too jealous of their reputations to put forward as constant, and as something in which full reliance can be placed, anything with which they themselves are not perfectly satisfied. Therefore it may be taken that the clever continuously indicating specific gravity apparatus, the continuously recording calorimeter (the perfection of which is assured by having the specific gravity indicator as an adjunct), and the carbon monoxide and carbonic acid apparatus—all of which we have seen in the laboratory of Messrs. Simmance and Abady, and which are described elsewhere—are each and all apparatus in which accuracy is to be found, on which the fullest reliance can be placed, and which will contribute to easing and facilitating the control and regulation of the specific gravity and quality of the primary product of any gas-works. The accuracy of these instruments has been tested against appliances that are not continuous, and against analyses that are time-absorbing. They are simple in construction—a matter to which special consideration has been given; as simple construction connotes simple operation and longevity. There is also the description published in our columns this week by Mr. E. V. Evans, of the South Metropolitan Gas Company, of a new plan of determining the percentage of nitrogen in coal gas; and here again we have a method that is labour saving, and in which the chances of error are reduced to a minimum.

We have referred here to these new aids to regulating the character of the primary product of gas-works, as when we look at the present lines of the gas business and judge

from them as to prospective development, we cannot help feeling that complete control of the quality of production, and the exclusion from it of deteriorating influences, must play a considerable part in the future commercial success of every gas enterprise.

The Thermal Conditions of Carbonization.

In the realms of physical research, one of the most difficult inquiries—difficult through the instability of the factors—in which one can engage is found in the thermal conditions existing during coal carbonization in retorts. In the settings themselves, in the composition of the coal, and almost, one might say, in a hundred-and-one different ways, external and internal, conditions arise that make results of one time (under the specific conditions then obtaining) inapplicable at others. Professor Vivian B. Lewes laboured under this disadvantage in the third of his Cantor lectures; and he deliberately set himself to prove, though admiring the value of their work, the unreliability for general application of the time and labour absorbing investigations that men of high talent in this particular work have carried out. The best that can be said of their results is that broadly they supply us with the premisses from which fairly dependable deductions for guidance can be made. The work done, pieced together, has increased the stock of knowledge as to the temperature conditions and the actions that occur during carbonization. Professor Lewes examines it in its different stages with his masterly analytical mind; and then, by the process of synthesis, he exposes the strength of the modern systems of the gas maker in comparison with the old, and also puts his finger upon their weaknesses.

We are reminded of the classical work of Euchêne and others, who have essayed to find the heat of decomposition of coal, by trying to construct as it were a heat-balance by taking the heat of the original coal, and then attempting to determine not only the thermal value of each of the products, but the losses of heat in the carbonizing process, so ascertaining by difference the heat of decomposition. At the best such work could not be accompanied by any amount of precision that would give unqualified confidence in the common application of the results; and this is accentuated by the diverging character of the findings of different experimenters. But their work, more especially that of Euchêne, has supplied some acceptable conclusions. One is that the amount of heat liberated in the process of decomposition of a coal increases in nearly regular ratio with the amount of volatile matter in the coal, and that the more oxygen a coal contains the more endothermic its reaction. Professor Lewes volleyed data at his audience in the early part of his lecture; but from the midst of it come figures that confirm the general deduction to which expression is just given. These figures show how the loss between the heat value of the coal and the heat value of the products descends from (say) a good type of gas coal to a good steam coal.

Passing from this more or less academic side of the subject of the thermal conditions existing during carbonization, there falls for consideration the channels of loss in the process of the decomposition of coal. These are varied; and they may be divided between the retort-setting heat losses, and the heat removed by the products. There are no means for practically avoiding the latter; and therefore savings of waste heat must be looked for in the setting itself—a saving of that which escapes up the chimney, by radiation, and so forth. Much has been done within memory in this way, particularly by regeneration. There is the fuel account too. The use of hot coke for charging the producers represents a saving of heat. If, as Professor Lewes points out, the whole of the heat of the combustion of the coke used as fuel could be utilized, it would reduce the fuel account to something like 8·6 per cent. of the weight of the material carbonized. We rather think Professor Lewes looks a little sceptically upon fuel accounts that are stated as low as 10·24 per cent., which is running down close to theoretical perfection, though 12 to 15 per cent. are quite usual returns from vertical working. There is one thing that Professor Lewes might have done, but omitted to do, in this part of the lecture, and that was to give credit to the Glover-West system for usefully employing in the setting a large amount of the heat of the hot coke leaving the retorts, by extracting from it heat for raising the temperature of the secondary air supply. That is one of the ingenious and (may we not say?) novel features of the system, and to it is partly attributed a notable low fuel account. The importance of a low fuel account in the works' economy and profit is not so generally recognized as it should be. A calculation as to what fuel savings represent in the aggregate will help to emphasize their value.

Perhaps to gas engineers the most interesting part of the lecture is that where Professor Lewes deals with the question of the transmission of heat in retort-settings. Here, again, no basis is strictly definable that can have universal application, owing to disparity of conditions. But the figures he gives have an approximate bearing, as well as the reasonings; and the figured argument will, we think, do much to stimulate a closer and more general interest in this matter than has heretofore been the case among those responsible for carbonizing operations. Here, however, we must not dwell upon particulars, but must pass to general points. There is a slipshod way of speaking of carbonizing temperatures as being "high" or "low," though we know very well that the coal is not actually carbonized at the temperatures existing in the flues or at the retort surfaces. As a matter of fact, the coal is carbonized at progressive temperatures which only, towards the end of the period of carbonization, approximate throughout the charge that at the retort surface. But for convenience we must have general terms expressive of method. Considering this progressive increase of temperature in actual carbonizing, we are brought sharp up against that ancient error, perpetrated by the use of light charges of having a pronounced irregularity of inner retort temperature. The mistake has been recognized now for some time; and the remedy has been applied. The high top temperature was responsible for the secondary actions that produce local troubles, together with the degradation of the products. When, however, a horizontal retort is charged as full as conveniently possible, conditions are approached that obtain in a vertical retort. An evil is largely removed, and a more uniform course of procedure is introduced into an operation that in itself under intermittent working is disuniform from beginning to end.

So, in an interesting manner Professor Lewes shows, from the temperature point of view (and we shall probably hear more of that from the chemical point of view in the fourth lecture), why it is that the new heavy charge practice in horizontal retorts is both theoretically and practically correct, and why the whole range of products is improved. The heavier charge is a step from barbarous to civilized coal treatment; and we are profiting thereby. Incidentally, Professor Lewes confirms the view that the greater proportion of the gas in a bulk-charged vertical retort finds exit from the retort *viâ* the central core of the coal, though there must, of course, always be, to the end of the carbonization period, a proportion passing up through the coke that is gradually assuming the temperature of the retort surface. Largely the same effect—the flow of a considerable volume of gas through the coolest portion of the charge—takes place in the thicker charges of the heavily fed horizontal retorts; and in the continuous verticals, there is also that replenishing of the upper part with fresh coal that affords protection to the gas from high retort temperatures. Incidentally, too, in this lecture we are shown that one of the serious troubles that was experienced in the ill-fated coalite process was the swelling of the coals at low temperatures. We all live and learn. When all the matters to which Professor Lewes calls attention are taken into account, we have to recognize the patent fact that, in the whole course of the process of coal carbonization (even the material used is not of uniform character), there is so much inconsistency that we can only extract from research general principles, knowing that the exact results of the research can only be applied by a positive reproduction of every condition. Thus we see why it is the 2·2 lb. test, allowing as it does a rapid transmission of heat through the tiny charge, is no reliable guide to what will happen in the case of a charge of (say) 10 or 12 cwt. under ordinary working conditions. Thus we see, too, why it is that in every gas-works watchfulness and chemical control are necessary to the upkeeping of carbonizing efficiency.

Three Practical Papers.

The Junior Gas Associations find in the multiplicity of matters that now engage attention in the technical and commercial spheres of the gas industry, that there is material and to spare for communications to their organizations. This week we publish three papers read at meetings of Junior Associations, which have about them several practical features. Before the Yorkshire Junior Gas Association,

Mr. E. Garsed, of Elland, read a paper on public lighting; Mr. W. Dawes, of Castleford, contributed a full account of the construction of a two-lift Gadd and Mason holder in the tank of a superseded single-lift column-guided holder at Normanton; while, before the Southern Junior Association, Mr. S. A. Carpenter was dilating on the question of the provision of domestic hot water supply—a subject that in these times is being taken up with enthusiasm by most undertakings that are commercially progressive.

In his paper, Mr. Garsed strikes a right note throughout. With its final ring we have much sympathy; and we hope that it will reach the ears of, and have a wholesome effect upon, all gas authorities who adopt a negligent attitude towards this question of public lighting. "The very name "of public lighting," says the author, "at once suggests "publicity, about which we are hearing so much just now. "And surely this direction is one in which we can shine—at "least, so far as the observant public are concerned." How often have we put forward similar argument, and how often have we urged the spending of a reasonable amount of money by gas authorities in showing local councils and the public what can be done in the matter of modern street lighting. But response has frequently taken the form of inquiry, "Why "should we spend money on showing improved systems of "lighting? Let those responsible for the public lighting "do it." To such shortsightedness—to such parsimony in furthering and protecting the interests of the gas undertaking—there is nothing to be said. Mr. Garsed is astonished at the number of flat-flame burners that still disgrace the public lamps of the country; and he naturally asks himself why more extensive public lighting improvement schemes are not taken in hand by the cheapest, and yet most efficient, method of betterment available—cheapest in the matter of initial expense, the inverted gas-burner against the metallic filament lamp; and cheapest also in the matter of running expense, the inverted gas-burner against either the metallic filament lamp or the vertical incandescent gas-burner.

One cause why improvement in street gas-lamps is not brought right up to modern methods is that so many local authorities have entered into electricity trading; and they do not regard it as being in the interests of the electricity undertaking, however much the interests of the ratepayers may be ignored, that the efficiency of modern gas lighting should have a living testimonial at the head of every street-lamp. Mr. Garsed thinks, too, that street gas-lamps should be completely under the control and maintenance of the gas undertaking. We are of like opinion. But the principal thing is that we do wish both local authorities and those gas companies who still lack enterprise in this matter would understand that proper conversion to a modern method of gas lighting would pay for itself, and so would be a good investment, apart from a public improvement. In his paper, Mr. Garsed shows how cheap is a 4½ cubic feet per hour upright incandescent gas-burner for 1800 hours' street lighting. Including labour and maintenance, it only costs £1 11s., with gas at 2s. 6d. per 1000 feet. An equally efficient inverted burner could be obtained consuming less gas than 4½ cubic feet per hour; while, as to maintenance, the author refers to a case of actual everyday experience in which the ratio of mantle consumption was 3½ for uprights to 1 for inverteds. "In this case, the saving in the mantle bill is quickly com-"pensating for the cost of alterations to lamps." It is really difficult to understand, with such experience before us, not only in this one place but in many places, why there should be so much inertia over the modernization of public lighting in the most economical way.

Jumping the long distance from the question of public lighting to gasholder reconstruction, it is clear that, though no cost figures are given by Mr. Dawes in his paper, the Engineer and Manager of the Normanton Gas-Works (Mr. E. H. Hudson) has to be congratulated on supplementing his gasholder storage at, by means of the Gadd and Mason system, comparatively low cost. Now Normanton has not a column-guided gasholder; as the conversion of a single-lift one to a two-lift spiral-guided one has put the whole storage under the latter system. There is no longer any question of confidence hanging to the disestablishment of holder columns, as spiral-guided holders, of large and small dimensions, have proved their stability and working regularity in all kinds of weather. The interest in this conversion at Normanton lies chiefly in the economical extension of storage capacity that it provides, through the utilization of the tank of the single-lift holder, as well as the lower angle-iron of the top curb, and the crown framing. The structural details of the work will be very useful to anyone requiring a holder of about 264,000 cubic feet capacity.

Next to the prospects offered by the gas-fire for business development, the provision of hot water for domestic and other purposes supplies a field of enterprise for gas undertakings in which, from the points of view of cleanliness, economy, and convenience, there are no real competitors. Labour-saving in the household, in business premises, and in public institutions, is a good card to play in these days; and the gas industry can offer several methods contributing to this end. Mr. S. A. Carpenter, at Friday's meeting of the Southern Junior Association, showed how well-equipped the gas industry is with the necessary appliances for hot-water supply. Electricians are freely acknowledging that they have nothing of practical character with which they can compete for this service with the gas industry. The thermal value of electricity puts it out of the running, especially when such efficiencies as Mr. Carpenter mentions can be obtained with gas appliances—efficiencies of 97 and 91·3 per cent. respectively with open and closed geysers, and 80 to 83 per cent. with circulators. In favour of water-heating by means of gas, there is every inducement that can be thought of—cleanliness, economy, rapidity, and availability both in large and small quantities. With the diversified requirements for hot water, we have a line of business that represents an all-day and an all-the-year-round load for a gas undertaking. It will be highly interesting to hear of actual experiences of business done by undertakings that have given encouragement to this promising "line."

Mill and Other Explosions.

Explosive factory dust has been responsible lately for some fearful disasters, which, in the daily papers, have more or less been described as "gas" explosions. The one at Liverpool—at Messrs. Bibby's oil-cake mills—was thoroughly investigated at the inquest on the victims; and it was clearly determined that it was due to highly inflammable dust resulting from the grinding of the materials used in the productions of the mill. The question about which there is doubt was as to how the explosive dust became ignited. Matches and cigarettes were found on some of the victims; but there was nothing to associate this fact with the catastrophe. The theory of Mr. Ernest Evans, the Mill Engineer, was that, in what was known as the "devil's cellar," a belt had been broken, this had disturbed the dust, and a simultaneous blowing of an electric fuse had ignited it, thus causing the explosion. The Assistant Manager (Mr. William Braithwaite) said he agreed with this theory. Beyond the theory it is impossible to go, and speak definitely. However, these repeated mill explosions have emphasized the danger of mill dust; and they should awaken mill owners to assure themselves that there is nothing left undone by them in the cause of safety. The serious explosion on the new super-Dreadnought "Orion" last Tuesday appears to have been due to the generation of oil-gas through the overheating of the bearings of one of two dynamos that were undergoing test.

One Cloud Lifted.

By adjustments, compromise, and a free interpretation of the Railway Commission's report, the representatives of the Railway Companies and of the railway men's Unions arrived at a settlement of their outstanding differences at the conference which concluded at the Board of Trade yesterday week. The representatives of the men have not secured all they wanted. But the principle of give-and-take has been applied, and a better understanding of what the Unions formerly regarded as vague has been arrived at. There is no need to enter into the details of the settlement. The great point is that this rids the national and industrial horizon of one of the threatened black clouds; and goodness only knows we have had enough of them this year. There will be thankfulness for the relief; but the fact has to be faced that the pockets of the public will have to suffer somewhat. If, however, there is a lasting peace, the public will not after a bit seriously mind this; though the pocket of a large section of the public is not inexhaustible, and there seems no end to the attempts to empty it. Among those depending very largely upon railways are gas companies and local authorities. The agreement lifts one load off their minds; but there is now always a lurking fear that something will happen at the seat of supplies which may temporarily interrupt the necessity for the services of railway companies in their goods traffic department.

GAS STOCK AND SHARE MARKET.

(For Stock and Share List, see p. 858.)

A TURN in the long lane of Stock Exchange depression came last week; and not before it was badly wanted. The hopefulness with which the conference between the Railway Boards and the men had been watched, proved not to be misplaced when terms were agreed upon on Monday by the contending parties. This brought immense relief to the Railway Market, and sympathetically affected others, even Consols rising nicely in spite of harder money. The opening gave fair promise, though things were very quiet. Consols at once looked up, Railways gained strength, and Americans were better; but the Foreign Market was uneven. The great improvement began on Tuesday, when Rails had a considerable rise, though towards the close there was some realizing of profits. Government issues were firm; and Americans still on the up-line. Business was not over and above active on Wednesday; but the tone was very good. Gilt-edged things were strong, and Consols rose $\frac{3}{8}$. Rails, after some hesitation, rose freely; but Americans were poorish. Thursday's chief occupation was the completion of the settlement—a rather large affair, which involved a failure. Consols looked like rising, but slipped back again; and Rails were rather fatigued. Friday was quiet, and the tendency was dull. Accounts were being closed for the holidays; and there was a good bit of realizing. Government issues weakened, and Consols fell $\frac{1}{8}$; Rails finished lower all round; and Americans relapsed. Saturday was very quiet, with a rather better tone. Gilt-edged issues were firmer, and Consols were steady at 77 to $77\frac{1}{4}$ (a rise of $\frac{3}{8}$ in the week); but Rails were no better. In the Money Market, there was a strong demand at advanced rates, which were very firm. Business in the Gas Market was much quieter—quite beginning to assume its holiday proportions. But no weakness was induced by inaction; and a fair number of quotations made moderate advances. In Gaslight and Coke issues, the ordinary was decidedly less busy but very firm; all transactions marked being within the narrow limits of the week before—$104\frac{3}{4}$ to $105\frac{1}{4}$. In the secured issues, the maximum was active at $85\frac{1}{4}$ to $86\frac{1}{4}$, the preference marking $102\frac{1}{2}$ and $103\frac{3}{4}$, and the debenture from $80\frac{3}{4}$ to $81\frac{1}{2}$. South Metropolitan was very quiet, and changed hands at 116 to $116\frac{3}{4}$. The debenture realized $79\frac{1}{4}$ and $80\frac{1}{4}$. In Commercials, the 4 per cent. was dealt in at 111 and $111\frac{1}{2}$, and the $3\frac{1}{2}$ per cent. at $105\frac{1}{4}$. Among the Suburban and Provincial group, Bournemouth "B" was marked at $16\frac{1}{4}$, Brighton ordinary at 158, British at $45\frac{1}{8}$, ditto debenture at $94\frac{3}{4}$ and $95\frac{1}{2}$, South Suburban at $122\frac{1}{2}$, and Tottenham "B" at $116\frac{3}{4}$. In the Continental companies, Imperial was in very good form, and from $186\frac{3}{4}$ advanced to 190 (a rise of 2), Union preference was done at $136\frac{1}{2}$, European at $20\frac{1}{2}$ and $20\frac{3}{8}$ (a rise of $\frac{1}{2}$), and Tuscan at $8\frac{3}{4}$. Among the undertakings of the remoter world, Bombay changed hands at $6\frac{7}{16}$, Primitiva at $7\frac{9}{16}$, and ditto preference at $5\frac{1}{4}$ and $5\frac{5}{16}$.

ELECTRICITY SUPPLY MEMORANDA.

Christmas Fires—City Fires and Inspection—Expert Views on Domestic Electrification—Single Point Heating not Good with Electric-Radiators—Water Heating and Cooking Problems—Mr. Seabrook on Open Meat Cells and Juice Retention.

WE are reminded of the serious fires that have occurred about Christmas time at certain large trading establishments through the fusing of electric wires, or the dropping of electric lamps. The reminder comes from two directions—from Mr. Duncan Watson, M.Inst.E.E., the head of a large firm of electrical contractors, and through an announcement relating to the disposal of the surplus of the fund that was raised for the relief of the families of the victims of the tragic Clapham Junction fire, a couple of years since. The question of the fund, however, has no special interest here; but what Mr. Duncan Watson says has. He has been giving advice on the subject of Christmas decorations to all tradesmen who use electricity, and who read the "Evening News." But despite his warnings, tradesmen will go their old ways, and run almost criminal risks with electric lighting. They are not altogether to blame. They have been taught by the suppliers of electricity that electric lamps can be employed in their window dressing with impunity and perfect safety where gas cannot be carried; and the result of the teaching has been a fearful sacrifice of both human life and property.

The article in the "Evening News" draws attention to the fact that, in Christmas decorations, there have been introduced in many shops cotton wool, imitation greenery, and crowded flimsy garments interspersed with electric lights. "Unfortunately," the article proceeds, "these gaudy windows are equally associated with disastrous fires, in which many lives have been endangered and many lost. The dangers are found in a lesser degree in houses and halls where Christmas parties are held, and similarly in the numerous Christmas bazaars." Mr. Watson's advice is, do not employ decorative material, unless it is fireproof or fire-resisting. Celluloid should also be used as little as possible; and linen decorations should be preferred to paper. Of course, this all means extra expense—trifling, it may be, but tradesmen will consider it. Mr. Watson claims that the experiment made at his offices at the time of the fire at Messrs. Arding and Hobbs, at Clapham Junction, also showed for the first time that an exploding electric lamp could set fire to material placed near it, and the experiment made history in the electrical world. It would be safer—more expense, and a depreciation of light!—if the electric bulb could be placed in an outer glass globe. Another piece of advice is that flexible electric light cords should not be nailed, pinned, or tacked to woodwork or fixture, nor be used as a support for handkerchiefs, laces, or paper. Mr. Watson has seen in a West-end shop a pin passed through a flexible electric wire; and at any moment a short-circuit might be formed there, and an outbreak of fire occur. He also gives the counsel that amateurs should not be allowed to interfere with an electric installation, or to replace a fuse. A piece of wire or a hairpin may be used for the latter; and "a mighty force may be accumulated that will bring destruction." Finally, he urges that wiring of a temporary character should be avoided. This requires greater safeguard than the ordinary installation. Mr. Watson will not be applauded in some quarters for showing that electric lighting is not the innocent that has been described in electrical literature.

The Acting Electrical Engineer to the Corporation of the City of London (Mr. H. R. Mott) has also something interesting to say on electrical fires in his annual report. He states that nineteen fires were visited during the year. Of these, eleven were of such a trifling nature that no damage was done to buildings, and four would not have occurred had the wiring been run in iron tubing instead of wood casing. Three fires of a most serious nature—of a most serious nature!—were caused electrically. Then we find a little later in the report that the electrical installations in the different departments of the Corporation undergo a monthly inspection; and this has resulted in an appreciable saving in minor repairs, inasmuch as defects are found almost immediately they occur, and before they have time to develop into more serious faults, and possibly disaster. If a monthly inspection of the Corporation installations is regarded as necessary by this electrical expert, it should be equally requisite wherever electric lighting is installed. The Birmingham Licensing Justices consider that, in the public safety, electrically lighted theatres and other places of entertainment should be inspected; and for this purpose they are appointing an electrical official.

In the address of Mr. S. L. R. Price to the Dublin Section of the Institution of Electrical Engineers, he deals, in a commonsense manner, with the question of heating and cooking by electricity. He is not overwhelmingly optimistic, and he is decidedly not pessimistic. But he faces the well-recognized difficulties boldly, and points to what he considers to be the best solution from the point of view of things as they are. This is a sensible way of looking at the position, and always to be preferred to that volatile enthusiasm and hollow pretence that are presented to us with fulsomeness week by week in some electrical quarters. In connection with the application of electricity for cooking and heating, Mr. Price mentions that the electrical engineer has to contend against both conservatism and strong sentiment. Apparently he finds that mistresses are of opinion (and later he shows that the opinion is well founded) that electricity is expensive; and that in any case they would be afraid to let their maids use it. What with compensation and insurance legislation, mistresses have to be a little careful over household innovations. Mr. Price gets to the practical side of his question. We see a good deal in electrical prints about the poisoned air of gas-heated rooms, and the denuding of the air of its oxygen. Of course, people who write such nonsense ought not to be out of the custody of someone with full mental balance. For their information and their reformation, Mr. Price points out that from tests made it has been found that, in an ordinary dwelling-room heated by a coal or gas fire, the air in the lower strata of the room changes probably about sixty times per hour, the air 3 feet up changes about twenty times per hour, and the air 6 feet up about twice per hour. Of course, these figures would be governed by varying conditions of ventilation, but might be taken as a basis of calculation in the ordinary dwelling-room with the usual provision of door, fireplace, and window.

Having stated these among other preliminary points, Mr. Price alludes to the hopelessness of adhering to the old method of trying to make one electric heater do the work of warming a room or passage of moderate dimensions. It may be calculated that a 1000-watt heater is necessary to do the work of heating a certain room; but it must not be supposed that the work can be efficiently or rapidly carried out if the whole of the energy is expended at one point. It must be split into as many small units as possible. But surely if this were done, it would increase considerably the cost of installation. If radiant heat be desired, four 250-watt radiators distributed about the room would, in the judgment of Mr. Price, prove very much more effective than one of 1000-watt capacity. But we do not see how this would economize the working cost, though it might increase the heating efficiency. It has often been stated that a four-lamp radiator will not heat up a room of the most moderate dimensions to a comfortable temperature in less than two or three hours. He gives some tests with a four-lamp radiator in a bedroom, which tests, in our opinion, confirm the statement. The radiator was switched on at 8.30 p.m.; and the temperature rose as follows:—

	Temp. Fahr.		Temp. Fahr.
8.30 p.m.	52·6°	9.45 p.m.	56·4°
9.0 ,,	55·4	10.0 ,,	57·0
9.30 ,,	56·0	10.15 ,,	57·4
10.30 p.m.	57·6° Fahr.		

So that the temperature was only raised 5° in two hours. In

addition to this, we should like to call Mr. Price's attention to what he no doubt is fully aware of, that it requires a greater expenditure of heat, by the same means of heating, to raise the temperature of a room starting at a lower figure—say 45° Fahr.—than it does starting at the higher figure of 52·6° Fahr. Looking at some tests made with house coal which he quotes, it is remarked that the temperature of the room when the fire was lighted at 7.40 a.m. was only 45·2° Fahr. (the outside temperature being 37°); and by 8.20 the temperature had been raised to 50·4° Fahr.—that is to say, in forty minutes the temperature had been raised 5·2° Fahr.—about the amount the temperature was raised with the electric radiator in two hours, with all the advantage of a higher initial temperature upon which to work. In the case of the electric radiator, the temperature outside the room at the end of the test was 52° Fahr., and outside the windows 45° Fahr., so that it was not a very cold night. But at 1d. per unit the capturing of that 5° increase upon 52·6° cost 2d. and two hours.

Passing to the question of hot water supply for domestic purposes, electricity comes off very badly indeed. The average hot-water demand per day in a medium suburban villa is calculated to represent about 110 gallons at 100°. If electrical boiling apparatus with an efficiency of even 90 per cent. be employed, the cost for current for heating this water, at 1d. per unit, would amount to 1s. 2·37d. per day. It is, of course, possible that some thermal storage system may eventually solve the problem electrically—electrical energy being supplied at a contract price per annum; but, look at it what way one may, one cannot shut one's eyes to works costs and cut prices indefinitely, even if customers are kind enough to flatten out the characteristics of their demand. To raise 110 gallons of water to 100° Fahr. would require approximately 14 units of electricity, assuming the boiling apparatus to have an efficiency of even 90 per cent., which is, of course, high. This consumption would require that the rate of charge should not be more than ¼d. per unit for heating purposes "in order to compete favourably with other methods." Therefore Mr. Price falls back on coke-fired boilers (which, he says, are extremely efficient). The initial cost of installation is quite moderate, and the working cost low. One of 50 gallons per hour at 100° Fahr. would be large enough to deal with the ordinary suburban ten-room villa, and would cost about 2d. per day to run.

Dealing with the cooking problem, instead of having a kitchen fire burning all day, he suggests that the various operations of roasting, boiling, washing, &c., should be performed individually as needed by electric means, each unit being switched on or off as required. [Experience makes us doubtful about this switching-off as required.] With electricity at 1d. per unit, it has, he remarks, been proved over and over again by actual trial that an ordinary three-course dinner for half-a-dozen persons should not cost more than 3d. to cook, breakfast 1½d., lunch and afternoon tea 1½d.; making a total of 8d. per day, including 2d. for a coke-heated supply of 110 gallons of water at 100° Fahr., which would suffice for a couple of baths at least, and general washing-up work. Mr. Price says (without giving any other information than that of time) that the following comparative tests between a coal and an electric oven were witnessed by him, and can be vouched for: 9 lbs. roast beef, coal oven took 2 hours 20 minutes, electric oven 1 hour 40 minutes; 2 lbs. sultana cake, coal oven took 1 hour 30 minutes, electric oven 1 hour 10 minutes; 4 lbs. fruit cake, coal oven took 2 hours 30 minutes, electric oven 1 hour 50 minutes. He explains that until recently electric ovens have been too flimsily constructed to be of real commercial value. What is wanted is something that will stand the rough usage of the ordinary domestic servant. "Those ovens that rely entirely on a polished surface to keep in the heat may be more or less sound in theory, but are not so satisfactory in practice. If they could be kept clear of draughts they would be all right, but as in everyday practice this is impossible, a good deal of heat must be lost." Mr. Price has evidently in mind those enlarged biscuit-tin looking arrangements that have had much puffing of late. He is inclined to think that a polished surface combined with lagging would give good results. As to the pots and pans, &c., in his opinion self-contained utensils will never do. It stands to reason that things of this sort which are constantly being scrubbed and rinsed under the tap would never last any length of time if they were self-contained. The hot-plate must be the solution, but not altogether the arrangement at present on the market. It is clear Mr. Price does not consider that domestic kitchen or other electric heating appliances have yet attained practical perfection.

Having had experience at West Ham, and now being identified with Mary-le-bone, Mr. A. H. Seabrook, the General Manager of the Electricity Department of the St. Mary-le-bone Borough Council, ought to know something about joints and cooking. Some time since, it will be remembered, he set himself up as an authority on the subject, and spoke of meat being tainted by poisonous gas fumes and such like, although this lover of the gas industry has been known to enjoy with considerable gusto many a gas-cooked dinner. Now he writes to the "Electrical Times" as follows:

> Users of electric cookers are rapidly realizing that the saving in the butcher's bill is sufficient to pay the cost of electric cooking, so that people who cook by electricity as compared with other methods (excepting perhaps paper bag), can cook for nothing. Users also know the improved flavour and appearance of electrically cooked joints. The most important point of all, however, is the effect of electric cooking on the meat cells; and it has been found that these are *more fully opened* and the juices are *better retained*, than by any *other process of cooking*. The meat is, as a consequence, more digestible and, therefore, more nutritive, so that weight for weight, the joint is of incomparably greater value when cooked in the electric oven. Needless to say I do not make this statement upon my own responsibility [Subtle Seabrook!]. But upon proper investigation it will be found to be a well-recognized fact; and when generally appreciated will weigh more with the public than any other argument in favour of electric cooking. I am trying to imagine what the "JOURNAL OF GAS LIGHTING" will say when they see this letter.

Why, the whole thing is truly Seabrookian. We have, by the way, tried often to get from electrical people some detailed particulars as to the type of gas-stove used, and as to the tests that it is supposed have been made in it, in comparison with an electric oven. We have so far failed. Will Mr. Seabrook oblige us with full information regarding the stoves and methods adopted in his investigations?

COAL STATISTICS FOR 1910.

A Slight Increase in Output.

OF the series of Blue-Books which comprise the Annual Home Office Report and Statistics relating to Mines and Quarries, the one most generally interesting is Part III., which deals with the output. Other matters also are recorded, inasmuch as the report refers to the output and value of all the minerals raised in the United Kingdom, the amount and value of the metals produced, and the exports and imports of minerals. The statistics for 1910, which (as has already been recorded in our pages) have lately been issued, show that the total output of coal mines and quarries during the year under review was slightly in excess of that of the preceding twelve months, while the monetary value was considerably more. Since 1873—the date to which the statistics go back—there has, in fact, been only one occasion (1907) when the output of last year was exceeded.

The total quantity of coal raised in 1910 was 264,433,028 tons, of a value at the mines and quarries of £108,377,567—the figures for 1909 being 263,774,312 tons, of a value of £106,274,900; for 1908, 261,528,795 tons, of a value of £116,598,848; for 1907, 267,830,962 tons, of a value of £120,527,378; for 1906, 251,067,628 tons, of a value of £91,529,266; and for 1905, 236,128,936 tons, of a value of £82,038,553. There was thus an increase last year as compared with 1909 of 658,716 tons in the output; and an increase of £2,102,667 in the value. The larger proportionate increase in the monetary return was due to the fact that the price of coal averaged 8s. 2·36d. per ton at the pit in 1910, as compared with 8s. 0·7d. in 1909. The value of the coal at the mines for each of the past five years has been: In 1906, 7s. 3·49d.; in 1907, 9s.; in 1908, 8s. 11d.; in 1909, 8s. 0·7d.; and in 1910, 8s. 2·36d. From this it will be seen that in the period named there were two years—1907 and 1908—in which the price realized averaged more than in the twelve months now under review.

With reference to the increase of 658,716 tons in the output last year, this was derived from England and Scotland; there being a decrease of 1,335,576 tons in the output of Wales, and of 9590 tons in that of Ireland. The increase in the output in England was 437,115 tons, and in Scotland 1,566,767. The output in England in 1910 was 183,913,511 tons, of a value of £72,301,746; in Wales, 39,104,583 tons, of a value of £21,934,121; in Scotland, 41,335,132 tons, of a value of £14,097,798; and in Ireland, 79,802 tons, of a value of £43,902. The term "coal" in these statistics, it should be pointed out, includes anthracite, the total output of which last year was 4,379,490 tons, valued at £2,560,685. This item shows an increase in output but a decrease in value as compared with the previous year, when the output was 4,258,980 tons, and the value £2,616,353. Of the total supply of anthracite, no less than 4,032,212 tons came from Wales; the largest producers being Carmarthen and Glamorgan. Of the remainder, 283,553 tons are credited to Scotland, and 63,725 tons to Ireland.

The prices of coal in 1910 at the pit's mouth in the different fields were as follows: In the Scotch coalfields, 6s. 9·85d. per ton; in the Northern coalfield, 7s. 10·55d.; in the Yorkshire, &c., coalfield, 7s. 5·17d.; in the Lancashire and Cheshire coalfield, 8s. 5·77d.; in the Midland coalfields, 7s. 2·34d.; in small detached coalfields, 8s. 8·56d.; in the North Wales coalfield, 8s. 2d.; in the South Wales coalfield, 11s. 0·48d.; and in the Irish coalfields, 11s. 0·03d. The average price per ton at the pit's mouth was for England 7s. 10·36d. per ton, for Wales 11s. 2·62d.; the average over the whole of the fields being, as already mentioned, 8s. 2·36d. The average price in the London market was 16s. 3d. per ton in 1910, compared with 16s. 11d. per ton in 1909, 17s. 6d. in 1908, 19s. 9d. in 1907, 15s. 9d. in 1906, and 15s. 6d. in 1905.

The quantity of coal exported last year (exclusive of coke and patent fuel, and of coal shipped by steamers engaged in foreign trade) was 62,085,476 tons, as compared with 63,076,799 tons in the preceding year—or a decrease of nearly a million tons. This decrease is due to the Continental countries having taken less coal from the United Kingdom. In 1908, the exports were 62,547,175 tons; and in 1907, 63,600,947 tons. The declared value of the 1910 exports of coal was £36,099,560, and of those of the preceding year £35,319,070. In addition to this, there was last year the equivalent of 1,606,755 tons of coal exported in the shape of 964,053 tons of coke, and of 1,323,712 tons in the form of 1,470,791 tons of manufactured fuel. Adding to this the 19,525,735 tons of coal shipped for the use of steamers engaged in foreign trade,

there is arrived at a total quantity of coal and coal equivalent shipped of 84,541,678 tons. The declared value of the exports of coke was £706,723, and of manufactured fuel £1,007,077.

With regard to the destinations of the coal exported, the first three countries, in the order of the quantity taken, are France, Germany, and Italy. France took 9,588,892 tons, of a value of £5,236,748; Germany, 9,005,515 tons, of a value of £4,425,872; and Italy, 8,784,504 tons, of a value of £5,161,373. In the case of Italy, the figure would be increased by upwards of 250,000 tons by the inclusion of the coal equivalents taken in the shape of coke and manufactured fuel. For the preceding year the coal, as such, exported to these three countries was: France, 10,408,010 tons; Germany, 9,671,992 tons; and Italy, 9,081,667 tons. The decrease in the total exports last year, it is pointed out, would have been greater, but for the fact that more coal was exported to South America than in the preceding year. The small table which sets forth the imports of "coal, culm, and cinders" into the United Kingdom shows some increase as compared with recent years. In 1910, the total amount imported was 36,037 tons, valued at £34,119; in 1909, 6318 tons, of a value of £8297; in 1908, 3842 tons, value £4689; and in 1907, 18,834 tons, value £20,845. Of last year's quantity, about 16,000 tons came from Germany, and 19,000 tons from the Netherlands. At the other end of the list is Hong Kong, with 4 tons. After meeting all the requirements from abroad, the amount of coal remaining for home consumption, out of the 264,433,028 tons raised, was 179,891,350 tons; and (reckoning the population of the United Kingdom at 44,911,346) this represents 4·005 tons per head of the population—an amount which has been slightly exceeded on only four occasions since 1873. In 1909, the amount left for home consumption per head of the population was 3·993 tons.

Turning now to the particulars in regard to the making of coke and briquettes, and the number of coking-ovens in use, in 1910, it is seen that returns of production of coke were received from 154 colliery owners (comprising 228 separate works), 1435 gas undertakings, and 15 other owners of coke-ovens (comprising 16 works). The counties of Durham and York furnished 68 per cent. of the total quantity of coke made in coking ovens; and 67 per cent. of the total number of ovens were being worked in those counties. Of the 244 works (other than gas-works) where coking plant is in use, bye-products were recovered last year at 77—this figure comparing with 71 in 1909. The principal bye-products were, of course, sulphate of ammonia and tar. Returns as to the manufacture of briquettes were obtained from all firms known to have been engaged in the industry; South Wales being, as usual, by far the largest contributor in this respect. Very fine slack, which would otherwise be of little value commercially is, it is pointed out, employed in making briquettes. The total quantity of coal used in the manufacture of coke last year is put at 34,964,208 tons; the amount of coke obtained being 19,331,461 tons (7,406,346 tons from gas-works, and 11,925,115 tons from coke-ovens), of a value of £12,731,885. Of the gas-works output, 6,427,832 tons came from England, 137,402 tons from Wales, 677,707 tons from Scotland, 153,831 tons from Ireland, and 9574 tons from the Isle of Man. Of the 22,983 coke-ovens in use, 16,037 were of the bee-hive pattern; the second and third in order being: Coppée, 1991; and Simon-Carvès, 1140. The Semet-Solvay pattern comes close on with 1055, and then the Otto-Hilgenstock with 1025. There were produced 1,607,666 tons of briquettes, which were valued (on the selling price at the place of manufacture) at £1,091,129.

A brief glance may now be given at some of the minerals other than coal which are referred in the Blue-Book. The quantity of bog ore taken last year from open workings in Ireland was very much the same as in the preceding twelve months; the figures being 2562 tons, of a value at the workings of £640, as compared with 2676 tons, of a value of £669, for 1909. In 1891, it may be remarked, the output of bog ore was 16,075 tons, valued at £8037. The output of iron ore in 1910 was 15,226,015 tons, of a value of £4,022,269. This was 421,633 tons more than in the preceding twelve months. The amount of natural gas obtained at Heathfield was 262,000 cubic feet, compared with 236,800 cubic feet in 1909. In 1904, the amount was 774,800 cubic feet. The output of oil shale from mines and quarries in the United Kingdom during 1910 (all of which was from Scotland) was 3,130,280 tons, of a value of £860,827; the figures for 1909 being 2,967,057 tons, valued at £815,937. Since 1906, no petroleum has been obtained. Last year the imports of petroleum amounted to 345,469,836 gallons, of a value of £5,662,882, as compared with 358,102,867 gallons, valued at £6,121,202, during 1909. The sources of supply were: United States, 251,818,363 gallons; Russia, 28,431,890 gallons; other countries, 65,219,583 gallons. Some increase is shown in the imports from both Russia and "other countries;" while the United States, on the other hand, exhibits a decrease of 17,000,000 gallons when compared with 1909. The value of the last year's imports is stated to be: United States, £3,746,404; Russia, £474,303; other countries, £1,442,175.

The "Chemical Trades Journal" says: A new method of employing gas or gas-air mixtures for heating has been developed in Germany—the Schnabel method. It prevents the separation of the gas-flame at high rates of flow, by compelling the gas to force its way through a porous granular mass of refractory material, in the interstices of which combustion takes place. It is stated that this method renders it possible to bring to combustion in the smallest space such a quantity of gas as would form a flame a yard high if allowed freely to escape.

PHYSICAL SOCIETY'S EXHIBITION.

In accordance with the intimation already given in the "Journal," the seventh annual exhibition of the Physical Society of London is being held to-day at the Imperial College of Science, South Kensington. The provisional arrangements included exhibits by the following firms whose names are known to readers of the "Journal."

Messrs. R. & J. Beck, Limited: A new model holophane lumeter, reading, by means of an electric light and graduated shutter, the brightness of a surface from 1-100th of a candle-foot to 200 candle-feet. Dow's new candle-power standard, comprising two incandescent filament lamps and a photometer method of judging their brightness. One lamp is a carbon, and the other a metal filament; and as a variation in the current used alters the brightness by a different order of variation, the current can be changed by a resistance till the point is found at which the two are exactly of equal power. This is then the standard, which can always be set independently of the strength of the supply current.

The Cambridge Scientific Instrument Company, Limited: The Whipple-Féry radiation pyrometer—a modified form of the standard Féry radiation pyrometer, suitable in cases where the latter cannot be used. The pyrometer consists of a long iron tube, into one end of which is fitted a blind tube, made of fire-clay, quartz, graphite, or steel, while at the other end are a small thermo-couple and mirror. The blind tube is inserted in a salt-bath furnace, crucible, or other source of heat to be measured; and the heat radiating through the tube is made to fall on the small thermo-couple, which is fixed at the focus of the mirror. Connection is made to a millivoltmeter or recorder, which indicates the required temperature. No focussing adjustment is needful; and the length of the pyrometer is made to suit any requirements. The Rosenhain portable potentiometer—a direct deflection form of potentiometer, designed by Dr. Rosenhain, of the National Physical Laboratory.

Messrs. Harry W. Cox and Co., Limited: Apparatus for the analysis of air, designed by Dr. J. S. Haldane, F.R.S., one of the Metropolitan Gas Referees. It is in four forms—a laboratory form, for the complete analysis of air, a portable form for the same purpose, another designed for use in mines, and a special form for factory inspectors, &c.—for the measurements of very small quantities of carbon dioxide.

Foster Instrument Company: The Foster patent strain-meter—a simple structure for the direct observation of strains in actual structures. Two important additions to the various forms of the Foster fixed-focus pyrometer.

Messrs. W. Sugg and Co., Limited: A still-water gas calorimeter designed by Mr. J. H. Coste. The gas is collected in a holder arranged on Mariotte's principle, from which it can be delivered at a fixed rate. It is burnt in a porcelain burner, which can be swung under the calorimeter vessel at the moment when the contact of the surface of the confining water with a central pointer indicates that 1-20th of a cubic foot of gas is left in the holder. The calorimeter vessel holds about 2 litres (3½ pints) of water, and is fitted with an efficient stirrer. The gas burns in a central combustion chamber of corrugated copper tubing, and the products pass upwards into an oval copper box, and thence through two flattened corrugated copper tubes downwards and out of the apparatus. An air space separates the calorimeter vessel from a large copper water-jacket, which reduces the effect of changes of temperature in the surroundings. The volume of water to be heated is determined by contact of its surface with a central point. The rise of temperature for ordinary coal gas is about 3°C. (37·4° Fahr.).

Messrs. Alexander Wright and Co., Limited: Levy's patent apparatus for rapidly recording the percentage of carbon monoxide and other gases; and Simmance and Abady's new patent automatic recording calorimeter and new patent apparatus for indicating and recording specific gravity. These instruments are described in detail in an article which appears elsewhere in to-day's issue, pp. 817-19.

At the last meeting of the Illuminating Engineering Society, the following were elected members: Mr. S. B. Chandler, of the Distribution Department of the South Metropolitan Gas Company; Mr. H. C. Head, the Engineer and General Manager of the Winchester Water and Gas Company; Mr. S. B. Langlands, Chief Inspector of the Public Lighting Department of the Glasgow Corporation; and Mr. W. J. Liberty, Public Lighting Inspector to the Corporation of London.

The "Builder" last Friday contained the following extract, under the heading of "New Motive Power," from the issue of Dec. 14, 1861: "An invention by Mr. Lenoir seems to meet with approval in scientific circles in Paris. It is simply the application of common gas, exploded in small quantities above and below the piston of what was once a steam-engine; the explosions being produced under regulation by the electric spark from a Ruhmkorff machine. The gas consumption is 500 litres per hour for each horse power; ten hours' work costing 1s. 3d. per horse power. This invention is about to be applied to locomotives on land and water; and the gas required may be produced by the decomposition of water itself."

PERSONAL.

Mr. PERCY TEW, at present engaged with the Leamington Priors Gas Company, has been appointed as Assistant at Felixstowe—succeeding Mr. Courtenay Church, who is leaving to assist his father, Mr. Worthington Church.

Mr. SAMUEL CUTLER has been elected a Director of the Barnet District Gas and Water Company, and Mr. ERNEST W. DREW, F.C.A., has been elected a Director of the Harpenden Gas Company—both in the place of the late Mr. Frederick Lennard.

At the meeting of the Windsor Town Council last Wednesday, it was resolved, on the recommendation of the Water Committee, to place the control of the water-works in the hands of Mr. E. A. STICKLAND, the Borough Surveyor. The decision was consequent upon the recent resignation of Mr. Christopher Sainty.

The Salford Town Council have confirmed the recommendation of the Water Committee for the appointment of Mr. L. H. A. GAUNT, B.Sc., of Warrington, as Water Engineer and Manager, for which position there were 52 applicants. Mr. Gaunt was educated at the Yorkshire College, Leeds, and took his degree at the Victoria University, Manchester.

Mr. WILLIAM SMITH, who for eighteen years has been engaged as Gas Manager on the estate of Mr. T. H. Miller, of Singleton Park, Lancashire, has, with Mrs. Smith, just celebrated the fiftieth anniversary of their wedding day, and been the recipients of congratulations from a large circle of relatives and friends. Formerly Mr. Smith was at the Garstang Gas-Works; but he received his training in those at Lancaster.

In the last number of the "JOURNAL" there was an advertisement of the Clonmel Corporation, inviting applications for the position of Manager of the gas-works. This was necessitated by the resignation of Mr. WILLIAM KNEESHAW, who has been in the service of the Corporation since Jan. 1, 1896, and of their predecessors, the Clonmel Gas Company, from 1855. He has consequently been connected with the gas-works for fifty-six years. The Corporation have granted him a retiring allowance of £120 per annum.

MODE EMPLOYED FOR TESTING THE CALORIFIC POWER OF PARIS GAS.

THE communication made by M. Lauriol, the Chief Engineer of the Gas-Testing Department of the Municipality of Paris, to the Physical Society of France, on the calorific power tests of Paris gas, has already been mentioned in the "JOURNAL" (*ante*, p. 294) but some further particulars as to the mode of testing adopted and the reasons for its adoption, may prove of interest.

It is observed that while in Germany testings of the illuminating power of gas have been discarded for some time past, in England they have been retained, and in one case supplemented by testings of calorific power, though opinion is now beginning to favour a change. In Paris, the tests for illuminating power have not been abandoned; but in the revised conditions of the contract for the supply of gas, provision has been made for tests of calorific power also. In France generally, however, recent experience is favourable to the suppression of testings of illuminating power. If gas of high candle power is manufactured, it is pointed out that expenditure is incurred to no purpose, having regard to the prevailing methods of using gas; whereas gas conforming only to a specified standard of calorific power would have sufficient illuminating power for the few consumers who continue to use flat-flame burners.

While illuminating power is *per se* a non-existent quality of gas, it is quite otherwise with calorific power. Nevertheless different definitions of calorific power are possible according to the conditions of combustion, &c.; and since various gases may have different relative values according to different definitions of calorific power, it becomes necessary to consider which of these definitions is to be accepted for the valuation of gas. The temperature of combustion of the gas is also of great importance for many uses of gas. Speaking broadly, the author says, the value of a gas depends on its calorific power and on its temperature of combustion. Practically for the three more important uses of gas—viz., for incandescent lighting, heating, and power purposes—the value of any gas can be adequately measured by means of a test of its calorific power.

The definition adopted for the calorific power in the testing of Paris gas is that the gas is burnt under constant pressure, or in the open, while both gas and air are at the prevailing temperature, to which also the products of combustion are brought, subject to the water produced remaining in a state of vapour. The condition of combustion under constant pressure accords fairly with the ordinary conditions of heating and lighting by gas, but not so well with the use of gas in engines. The cooling of the products to the prevailing temperature accords fairly with the conditions of heating water or a room, but not so well with the conditions of lighting by incandescence or the melting of metals. The measurement made is of the calorific power of the mass of gas which has a volume of one cubic metre at the prevailing temperature and pressure, but thence is deduced that of the mass of gas which has a volume of one cubic metre in standard conditions—viz., at 0° C. and 760 mm. The proviso that the water produced shall remain in a state of vapour was introduced after consideration of the relative importance of the gross as compared with the net calorific value. In view of the fact that a considerable excess of air passing through the calorimeter will retain a large quantity of water vapour, the heat of condensation of which will be lost, it is clear, M. Lauriol says, that there is uncertainty about the determination of the gross calorific power. On the other hand, since the water condensed will be less by the excess of water vapour thus carried away, and since the net calorific power is arrived at by deducting the latent heat of the condensed water from the total heat received by the calorimeter, the final result for the net calorific power of the gas is not affected by the passage of an excess of air through the calorimeter. It is on account of the greater degree of exactness which is thus attained, with varying rates of air supply, in the determination of the net calorific power of gas that it has been preferred to the gross calorific power as a measure of the value of Paris gas.

A set of provisional instructions for making the determinations of calorific power has been drawn up, with the assistance of M. Emile Sainte-Claire Deville, Engineer of the Paris Gas Company, and M. Girard, Principal of the City Lighting Laboratory. In regard to the instrument to be used, the calorimetric bomb was rejected because it requires highly-skilled manipulation, and its conditions of pressure are not those prevailing in the ordinary uses of gas. Hence the bath-water heater type of calorimeter was preferred. Of this type, the Boys and the Junkers appear equally satisfactory; and the latter has been adopted in the present instance solely because of its wider dissemination on the Continent. In order to avoid the errors which may be introduced if the rate of consumption of the gas is very low or very high, a rate of 60 litres (2·12 cubic feet) per hour has been fixed on for the tests, and a governor is used to ensure constancy. Six litres (0·212 cubic foot) of gas are burnt for each test—a special meter which passes exactly this quantity per revolution of the drum being used. Three determinations, each on 6 litres of gas, are made in succession, and the mean value is taken. The collection of the condensed water is made continuously while 60 litres of gas are burnt—thus about covering the time occupied by the three sets of observations and the necessary intervals between them. The rise of temperature of the water circulating through the instrument is fixed at about 8° C. (14·4° Fahr.). The water supply is from a tank in the room; and before each test cold water is admitted to the tank until its contents are about 4° C. lower than the temperature of the air of the room. The temperature of the water flowing from the calorimeter thus becomes about 4° C. above that of the air of the room. With only this difference, the heat carried off by the gaseous products cannot cause a sensible error in the determination, even if there is a big excess of air.

The thermometers used have a comparatively short range, and are divided into tenths of a degree C.; the intervals between the divisions being about 0·7 mm. (*i.e.*, 36 divisions to the inch). With a lens, 0·01° may be read. In regard to the correction of the volume of gas for temperature and pressure, the temperature is read on a thermometer fixed at the side of the meter, and the pressure on a barometer, the mercury in the well of which is in communication with the gas instead of with the air. Thus the absolute pressure of the gas is read off directly. The correction may most readily be applied by means of a special slide-rule. Following the instructions, and with gas having about the required net calorific power of 4700 calories per cubic metre at 0° C., 760 mm. and dry (492 B.Th.U. per cubic foot at 60° Fahr., 30 in. and saturated), the weight of water passed through the calorimeter in one observation on 6 litres of gas will be about 4 kilos. (8·8 lbs.), the weight of water condensed from the combustion of 60 litres of gas will be about 50 grammes (1¾ oz.), and the degree of accuracy which may be relied upon in the determination will be about 1 per cent. The largest errors appear to be those of the gas-meter.

Engineering Staff of the Gaslight and Coke Company.

Several changes in the engineering staff of the Gaslight and Coke Company are imminent, and will probably take effect soon after the commencement of the New Year. Mr. JOHN WILTON retires, after a service of forty-seven years, and will be succeeded at the Bow Common works (where he was Engineer-in-Charge) by Mr. A. C. M'MINN, jun., an Assistant at the Fulham station and son of Mr. A. C. M'Minn, sen., who retired some years since from his post of Resident Engineer at Kensal Green. Mr. R. BIRKETT, who was temporarily placed in charge at the Stratford works upon the amalgamation with the West Ham Gas Company, returns to his post of Resident Engineer at Bromley. Mr. JOHN HORNBY, who was for awhile placed in charge at Bromley, will be transferred to Horseferry Road. The Barking and Woodford works of the Barking Gas Company and the Chigwell, Loughton, and Woodford Gas Company respectively will cease to be manufacturing stations, and will be used only for purposes of storing and distributing gas. Mr. W. B. REIDIE, of Barking, will become the Engineer at Stratford; and Mr. F. SMALLBONE, the Engineer at Woodford, will avail himself of the terms of the Act of Parliament sanctioning the absorption to retire from office.

We learn that Mr. B. F. Smith, son of Mr. F. R. Smith, of Messrs. Parkinson and Cowan, has passed the examination of the Institution of Civil Engineers which will allow of his transfer from the class of students to that of associate members.

CHEMICAL CONTROL OF GAS-WORKS.

That the inventive spring which one is accustomed to associate with Messrs. Alexander Wright and Co., Limited, is not exhausted is evident from the instruments produced by Mr. John F. Simmance and Mr. Jacques Abady which the firm have on view at the exhibition of the Physical Society of London being held to-day and to-morrow at the Royal College of Science, South Kensington. It is evident that the lines which have made the name of the firm what it is are still being pursued—viz., facilitating the production by gas engineers of a commodity of constantly increasing value and excellence.

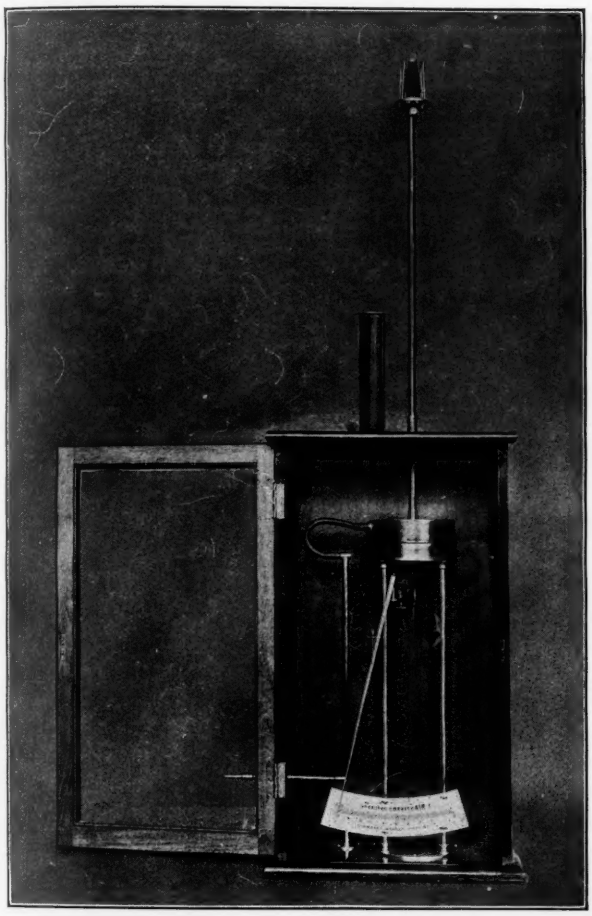


Fig. 1.—The New Continuous Specific Gravity Indicator.

The subjects to which Messrs. Simmance and Abady have now particularly directed their attention, with the resultant production of the instruments we shall presently describe, are in four separate and distinct fields of real scientific and practical interest to those engaged in gas manufacture and cognate industries. They are the automatic estimation of specific gravity, the automatic examination of producer gases, simplification in gas analysis, and the automatic estimation of calorific values.

Automatic Estimation of Specific Gravity.

A criticism which one instinctively applies to something seen for the first time of great simplicity is, "How simple. Why was it never thought of before?" This is exactly what one feels inclined to say on looking at the Simmance-Abady specific gravity indicator, as illustrated by fig. 1. We have here a small stream of gas passing over the crown of a suspended bell, and being burned at an orifice or burner on an ascending tube. The actual weight of the body of gas passing across the crown of the bell raises or depresses it in exact ratio to its weight as compared with the atmosphere. The extent of this rise or fall is indicated by a pointer on a dial subdivided into thousandths, or recorded by a pen on a chart. The bell moves up and down in exact sympathy with the slightest change in gravity; and thus forms a continuous and automatic indicator and recorder, with the peculiarity that it is practically without any moving part. There are two things which enable this result to be brought about—firstly, the conception of the idea (which readers of the "Journal" who are interested will no doubt gather fully when the patent specification is published); and, secondly, the very fine workmanship embodied in the construction of the instrument.

Many of the uses to which the instrument can be put are quite obvious, and well understood by many gas managers who regularly use the same inventors' specific gravity bell. There is one point, however, in the manufacture of gas, which only the provision of this apparatus (or something equally accurate and continually automatic) will enable gas engineers to develop, and that is the provision of a gas of regular and unchanging gravity. A regular density or gravity, coupled with a regular calorific power, will mean perfection of air regulation in burners; but a regular calorific power has its advantages to a large extent nullified if it is accompanied by an irregular density. It is unnecessary for us to say that, in these days of competition, it is imperative that incandescent burners should be used at the point of greatest advantage or duty, which connotes perfect air admixture. Now, take what burner one will, whether for lighting or heating, and regulate it with the admirable means provided by modern burner makers. Change the calorific power, and the effect upon the light is comparatively unimportant; but supply the burner with gas of different gravity, the result of course is disastrous. Now, the importance of this instrument lies in the fact that before one can measure any function, one requires something with which to measure it. We opine that what we say about gravity has long been grasped by gas engineers. What was wanting has been a simple apparatus of constant application to measure it. On this ground alone, we think the Simmance-Abady specific gravity indicator will arouse considerable interest among those who work in the field of gas manufacture.

There are many uses to which the instrument can be put; and no doubt the firm responsible for its sale will place these before engineers. One or two might, however, be pointed out. It shows the percentage of water gas in a mixture. It shows the percentage of any constituent the gravity of which is known. It shows that very elusive detail the presence of which has an important bearing on percentage of loss by "leakage"—that is to say, the moisture present in gas. It shows whether a diminution of quality is due to the nitrogen or carbonic acid, or to a lessening of hydrocarbons. The graduations of the instrument are to 0·01; and it can be read to 0·0025, taking air = 1·0.

Estimating Carbon Monoxide and Carbon Dioxide.

Next we have an apparatus (fig. 2) of entirely different scope and utility, and one which Messrs. Simmance and Abady tell us has been produced in collaboration with Mr. Leonard Levy. It appears also to fill a want, and to break entirely fresh ground; for it is an instrument which automatically records on a chart the percentage of carbon monoxide in gaseous mixtures. Chemists who have worked with gas will be acquainted with the difficulty of rapidly and accurately estimating carbon monoxide in producer gas, in waste gas, or in illuminating gas, even when a laboratory instrument manipulated by a technician is used. From present methods to an accurate automatic and continuous record is indeed a long jump; but an examination of the instrument at work exhibits a simplicity which is the first necessity in a recorder. The apparatus is an embodiment of Mr. Levy's iodine pentoxide method described last week at the Society of Chemical Industry,* together with an adaptation of Simmance and Ababy's well-known carbonic acid recorder; and the way in which the difficulties of the

* See "Journal," Dec. 12, p. 760.

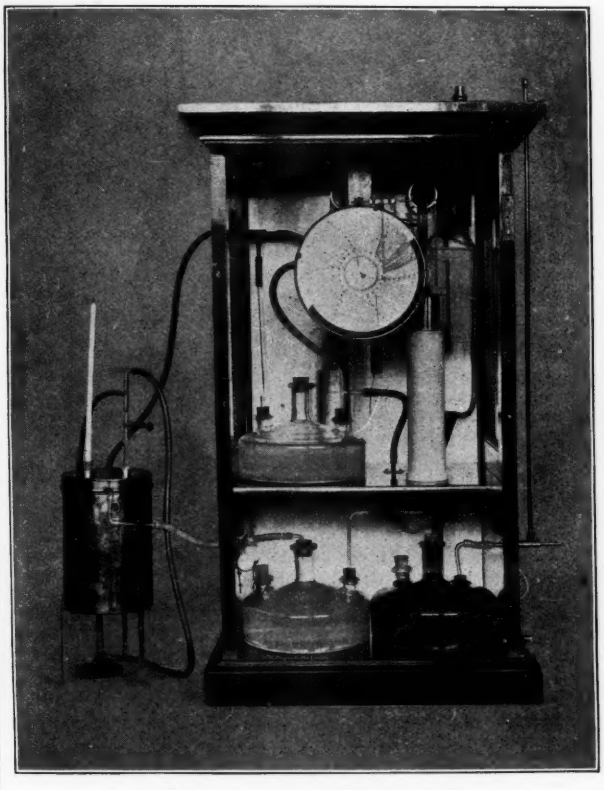
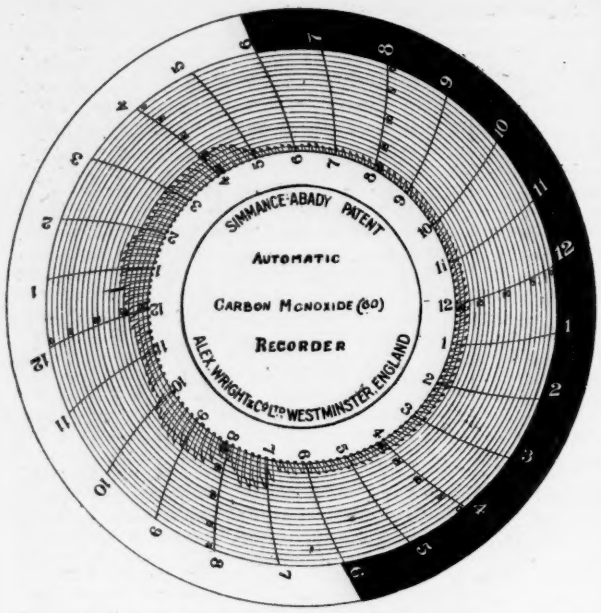


Fig. 2.—The Carbon Monoxide Recorder.



A Chart from the Carbon Monoxide Recorder.

adaptation are overcome shows great ingenuity. A facsimile of a record made by the instrument is produced. The blank portion of the chart shows the percentage of carbon monoxide.

The oxidation method devised by Mr. Levy and utilized in the above recorder and in the gas analysis apparatus described below appears to have struck the note of novelty, and to have survived the ordeal of criticism by members of the Society of Chemical Industry. The application of it to gas analysis certainly seems exceedingly simple, so much so that it drew the criticism of a member of that body (savouring of trade unionism, and being therefore fashionable) that the production of instruments which enabled skilled chemical work to be done by unskilled persons was very much to be deprecated. Messrs. Simmance and Abady inform us, however, that this has been their object in bringing forward the gas analysis apparatus now to be more particularly described, and illustrated by figs. 3 and 4.

The apparatus, as stated earlier, is based upon the idea of simplifying the process of technical gas analysis, and is made under Mr. Levy's patent No. 20,692 of 1911. By its means the percentage of many constituents of a gaseous mixture can be ascertained by an unskilled person, by a process which is varied in detail according to the constituent being sought for; and it has the general underlying feature that the percentage of the constituent present is in every case determined by turning a tap co-incidentally with a sharp colour change which is quite unmistakable.

To illustrate the method, the following description of the means of ascertaining (say) carbon monoxide will suffice; the references being to the diagrammatic representation shown in fig. 4. Gas enters the two special absorbing vessels A and B. The first of these serves to remove all unsaturated hydrocarbons, and the second absorbs any carbon dioxide and fumes from the absorbent in A. It then passes through the drying-tube C, indicated by the dotted line, and thence through the selective oxidation tube H. The latter is connected to the three-way cock E, one branch of which is a bye-pass, the other leading to the decolorization vessel F. The gas is drawn through the apparatus by means of water running out of the graduated water-aspirator G. A fresh amount of standard solution coloured red is placed in the decolorization vessel F; and the sudden change of colour from red to white indicates the absorption of 20 c.c. of carbon dioxide—*i.e.*, corresponding to the presence of 20 c.c. of carbon monoxide from which the carbon dioxide was derived. The scale reading on the aspirator gives the percentage of carbon monoxide which, for purposes of greater accuracy, can be corrected by the tabular

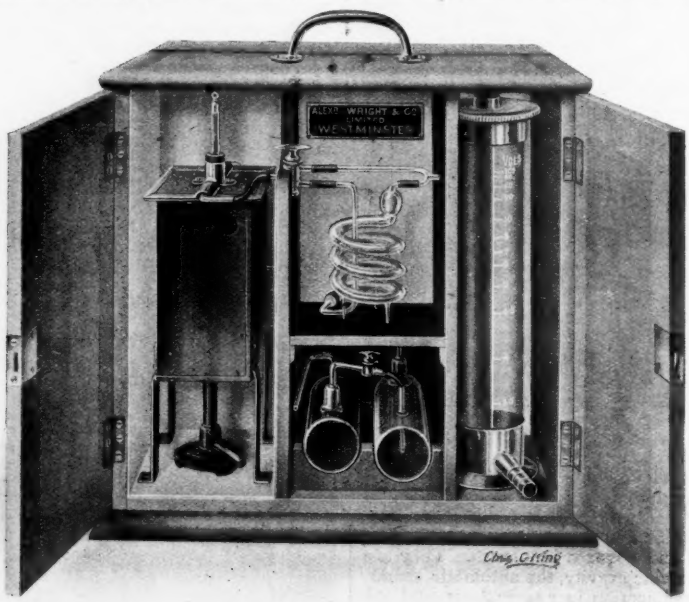


Fig. 3.—Gas Analysis Apparatus or Carbon Dioxide Recorder.

number. The selective oxidation tube D has to be kept within certain temperatures, and is therefore contained in the oven D heated by means of a small burner K. The apparatus is made up into a simple portable form as shown, and a test can readily be made in five minutes. By varying the selective oxidation agent and the absorbent employed, the gas can be similarly examined for other constituents.

Patent Recording Calorimeter.

The last instrument to be described is Simmance and Abady's patent recording calorimeter. This instrument would have been impossible had it not been for the physical facts demonstrated by the specific gravity indicator mentioned above. Indeed, the recorder may be looked upon as a combination of the specific gravity indicator and a sensitive differential recording thermometer. The gravity portion, however, is utilized not as an indicator, but as a means of automatically loading a pressure governor. The gas on entering the apparatus passes first a sensitive regulator, whence it enters a chamber, the exit of which is controlled by a valve. This valve is suspended by a balance; and it is this balance which is acted upon directly by the actual weight of gas, as, after passing the governor mentioned above, the gas is branched in a separate stream over the specific gravity bell, and is burnt above it as a separate jet. Thus, if a heavier gas is fed to the calorimeter, the effect of its weight is also felt in the specific gravity balance, which, being loaded additionally by the extra weight of gas, affords an extra pressure to the original main flow of gas passing to the burner, which is the source of heat in the calorimeter. That there is ample power in the gas density alone to regulate an auxiliary gas supply will be appreciated when it is mentioned that the passing of London gas through the specific gravity regulator relieves the valve balance of over 50 grains of weight. By these means, a constant supply of gas to the burner is maintained, irrespective of any changes in specific gravity.

The differential thermometer is composed of opposing diaphragms actuating a four-bar mechanism, carrying a pen and inscribing on a disc chart in the style of the well-known Wright's pressure registers. The diaphragms are lined throughout with a plating of palladium, are hermetically sealed, and contain air under pressure. The use of palladium in preserving the surfaces of metals where oxidation or corrosion would directly interfere with the working of the apparatus has enabled the inventors to take the bold step of sending out a complete calorimeter so prepared that it only requires connecting to a gas supply to show the

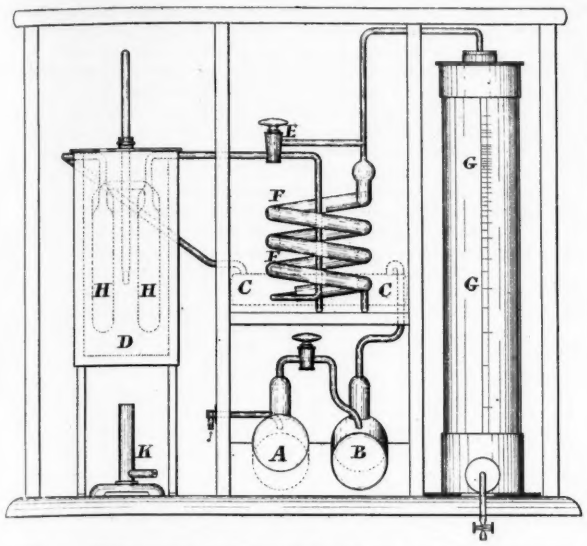


Fig. 4.—Diagrammatic Reproduction of the Gas Analysis Apparatus.

correct net calorific power of the gas. That is to say, no meter or other measuring apparatus is required, and the instrument, when taken from its packing case and set up, will deliver gas to the burner at a constant and invariable rate per hour, whatever fluctuations may take place in the gravity of the gas the calorific power of which is being recorded.

The automatic adjustment of pressure to suit various gravities is a feat that would seem almost impossible. But no one who has inspected the specific gravity indicator shown in fig. 1 and has watched its perfect obedience to the slightest change of density, will doubt that the principle embodied is one which possesses wonderful capabilities in many directions. The recording calorimeter (an illustration of which we shall publish next week) is made in the disc type for gases up to 600 B.Th.U. net—being thus suitable for most of the gases supplied in the United Kingdom. This comparatively low figure has been decided on in order to give an open scale. For gases of higher calorific values, however, a larger chart can be supplied, or the same size chart used with a more compressed scale.

The New Collaborator.

The reference to Mr. Leonard Levy in connection with the above inventions renders this a convenient opportunity for mentioning that he is now in charge of Alexander Wright and Co.'s chemical department. Mr. Levy's qualifications are such as to enable the Company to commence research into many matters concerning gas manufacture and manipulation hitherto quite neglected; and the future no doubt will show advances in many directions. Mr. Levy is an M.A. of Cambridge, B.Sc. of London, and F.I.C. He gained first-class honours at all stages of his studentship, and has won the Neil-Arnott exhibition and medal of the London University for physics. At Cambridge University, he gained the Gordon-Wigan University prize for research in chemistry. He has received two grants from the Government Grant Committee of the Royal Society for researches, and is responsible for several technical publications on platino-cyanides, radium, and other subjects. We wish him a successful career in his new undertaking. His success, in collaboration with the experience of Messrs. Simmance and Abady, will be to the enlarged advantage of the gas industry.

THE "METROGAS" NITROGEN TESTING APPARATUS.

By Edward V. Evans, Chemist, South Metropolitan Gas Company.

As a result of recent improvements in the methods of coal carbonization, it has been considered desirable to formulate an accurate method of ascertaining the percentage of nitrogen in coal gas; and an attempt has been made to render the apparatus serviceable as a portable works' test. In most cases, it has hitherto been usual to make a complete analysis of the gas for the purpose of determining the nitrogen content; and this quantity is generally arrived at by difference—that is to say, by subtracting the total volume of all other constituents determined, from the volume of the original sample. Not only does the complete analysis of coal gas require the service of a skilled operator, but it also occupies considerable time. It is known that gas engineers will take advantage of any additional means of controlling retort-house working, especially in the case of adopting new systems of carbonization; and this knowledge justifies the publication of a short account of the laboratory work carried out on this subject of estimating nitrogen, together with a description of the method and apparatus finally adopted.

The first method to suggest itself would be that of exploding a suitable volume of the gas under examination with oxygen of known purity, and of measuring the volume of residual gas after explosion. The results of experiments carried out in this direction showed that the volume of residue after explosion was seriously influenced by the nature of the gas exploded. Samples of gas were collected, and in each case various constituents were extracted before explosion. It was observed that the quantity of residual nitrogen gas was increased when removing the greater heat-producing constituents prior to explosion.

The literature on the subject of estimating nitrogen was investigated; and it became evident that the most satisfactory results had been obtained by using the principle recommended by Dumas for the determination of nitrogen in solid organic compounds—viz., of combusting the carbon and hydrogen over heated copper oxide, and of determining the gaseous volume of the residual incombustible nitrogen. The Dumas test for nitrogen has to serve the purpose of computing the constitution of organic compounds; and the highest degree of accuracy is required. In the case of a gas-works' test, the method required is one in which the chances of error in manipulation have been reduced to a minimum, and which shall be known to be capable of yielding accurate results when operating with moderate precision.

The apparatus as finally designed, and which has been in daily use for some months at each of the stations of the South Metropolitan Gas Company, is shown in detail in fig. 1, and in photograph in fig. 2. It consists essentially of three burettes, which, for the purpose of the description, are termed—reading from right to left—sampling burette, acid burette, and alkali burette. Combustible gas is slowly passed over strongly heated copper oxide contained between two plugs of pure asbestos in a quartz tube, and there is eventually obtained an unalterable residue representing the nitrogen content of the gas under consideration.

Apparatus for the generation of carbon dioxide is provided; and this gas serves (1) for displacing air from the apparatus, (2) for carrying small quantities of incombustible gas through the system, (3) for proving the apparatus gas-tight. The acid burette is used for collecting gas from which it is not convenient to extract carbon dioxide, and contains brine slightly acidulated with sulphuric acid and tinted with methyl orange. The alkali

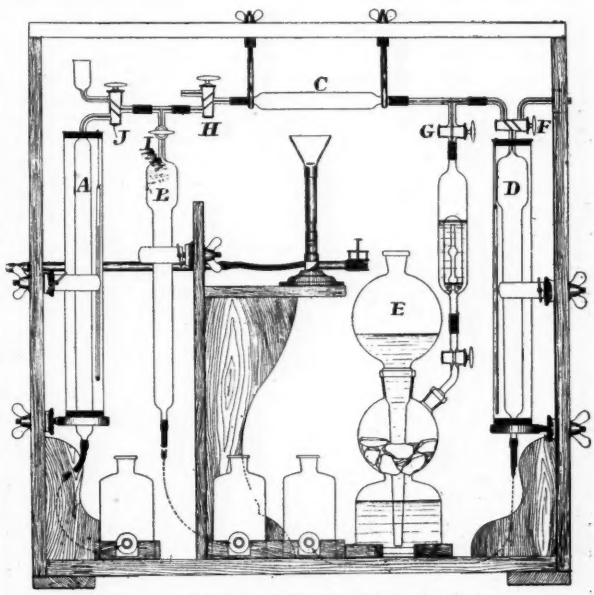


Fig. 1.—"Metrogas" Nitrogen-Testing Apparatus.

burette, containing caustic soda in solution, is employed for the removal of carbon dioxide. The sampling burette is supplied with a water-jacket and thermometer, as is also the alkali burette, in which the final measurement of residual nitrogen is made. For convenience' sake, the method of operating with this apparatus is given first in abstract and then in detail.

Abstract.

1—Gas lighted under quartz tube.
2—Apparatus proved sound under pressure created by carbon dioxide from the Kipp's apparatus.
3—Sample of gas aspirated into the sampling burette.
4—Apparatus cleared with carbon dioxide gas.
5—Sample of carbon dioxide taken into 100 c.c. acid burette.

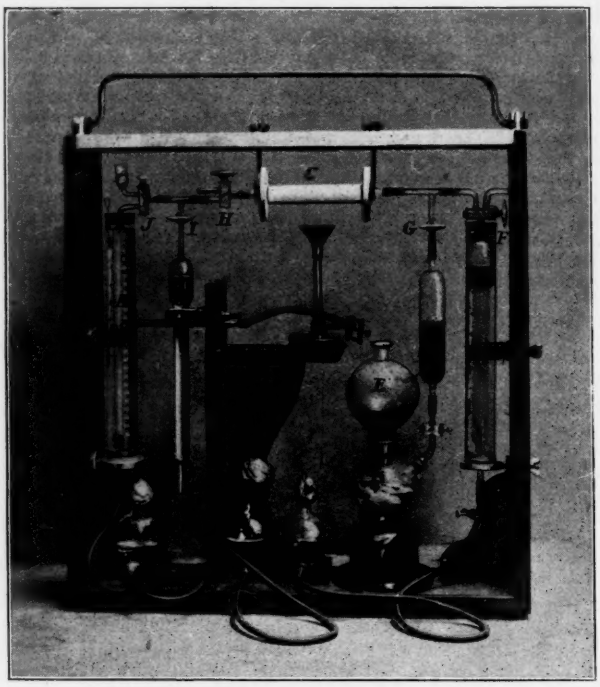


Fig. 2.

6—Determination of residue (if any) left after treatment of the 100 c.c. of carbon dioxide with caustic soda in alkali burette.

7—Gas slowly passed over heated granular copper oxide and received in the acid burette.

8—Gas slowly returned to the sampling burette *vid* the copper oxide tube.

9—Gas again slowly passed over copper oxide into the acid burette.

10—About 40 to 60 c.c. will now be found in the acid burette, and carbon dioxide gas is passed slowly over heated copper oxide to displace any remaining nitrogen, and the total volume in the burette hereby made up to about 100 c.c.

11—Contents of acid burette treated with caustic soda in alkali burette, by passing the gas to and fro until the amount of residue is constant.

12—The volume of residue, after the necessary correction for temperature, represents the percentage of nitrogen.

13—At the operator's will, this residue may be again passed over heated copper oxide by first admixing a small quantity of carbon dioxide to give sufficient volume for working.

DETAIL.

1—*Soundness of Apparatus.*—Carbon dioxide gas is first employed for proving the apparatus sound, and cocks F, I, and J are closed, with G and H open. The cock of Kipp's apparatus is opened and the gas apparatus placed under pressure by this means. With sound apparatus, the generation of carbon dioxide may be suddenly arrested by opening and closing the cock J to the air.

2.—*Bunsen Burner.*—The quartz tube is heated in the tip of the slot bunsen flame. About 3 or 4 inches length of tube should be heated; and the base of the tube is maintained at red heat.

3.—*Passage of Carbon Dioxide for Expulsion of Air.*—With cocks F and I shut, and the remaining cocks open, carbon dioxide is passed through the apparatus and makes its exit at the cup on the cock J. A drop of water placed in the cup serves as an indicator of the passage of carbon dioxide. The air is displaced from the capillary tube between cocks F and G by opening the cock F and drawing carbon dioxide into the sampling burette; the excess being expelled by reversing the cock and opening to the atmosphere.

4.—*Sample of Gas.*—It is usual to collect a slow-running sample of gas over mercury, and during an extended period, in a separate vessel specially constructed for the purpose (fig. 3). After agitating or shaking the sample, 100 c.c. may be aspirated into the sampling burette of the apparatus by the capillary connection passing through the side of the wooden case. The temperature in the water-jacket is then observed. The Somerville stopcock, designed for displacing gas in capillary tubes by means of mercury maintained under a slight head in the adjoining glass cup, is recommended for the purpose of transferring gas from the sampling vessel to the sampling burette.

5.—*Examination of Carbon Dioxide Used.*—Closing the cock J and opening I, about 100 c.c. of carbon dioxide are drawn into the acid burette. Closing the cock H and opening J to the alkali burette, the 100 c.c. is passed forward and backward until no more is absorbable by caustic soda. The amount of residue should not occupy more than 1 inch length of the capillary tube (thus representing approximately 0·05 c.c.). By this means, not only is the purity of the carbon dioxide assured, but also the fact that all air has been expelled from the apparatus. The minute residue in the alkali burette is expelled by transferring it to the acid burette, and then driving it through the cup of the cock J to the atmosphere.

6.—*Passage of Gas over Copper Oxide.*—Closing the cocks G and J with only H open, the clamp at the base of the sampling burette is screwed down tightly; the reservoir is raised to the top of the case, and cocks F (copper oxide direction), H, and I are opened; the reservoir of the acid burette being on the bench. By gradually opening the clamp, gas is allowed to flow slowly at the rate of about 10 c.c. per minute. Without altering the clamp, the gas is then returned to the sampling burette by reversing the positions of the reservoirs. The gas is then again passed forward as before; and this time the liquid of the sampling burette should be drawn to the junction of the T piece above the cock G. The cock F is then closed. It will be found that the acid burette is only about half-filled; and the total volume of this burette is made up to approximately 100 c.c. by slowly admitting carbon dioxide through the cock G. This serves the purpose of expelling all nitrogen in the copper oxide tube and capillaries.

7.—*Absorption of Carbon Dioxide.*—With the cock H closed and cocks I and J opening to their respective burettes, the gas of the acid burette is passed forward and backward to the alkali burette until a constant volume is obtained. The gas is completely displaced from the acid burette and capillaries before taking the final reading. The volume of residue indicates the percentage of nitrogen in the gas, providing the above conditions are adhered to. A correction, if necessary, is made for differences of temperature in the two burettes.

Finally, it is at the operator's will to become assured that the residue is unalterable, and, if desired, the nitrogen residue, as found above, may be diluted with carbon dioxide gas in the acid burette for the purpose of obtaining a workable volume, and can be submitted to the same process as before.

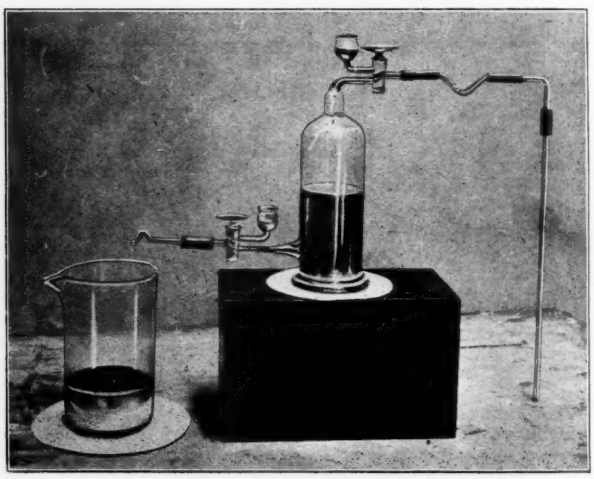


Fig. 3.

The regeneration of copper oxide may be effected *in situ* by driving air from the sampling burette over the heated material through the cup on the cock J. This operation will occupy a few minutes, and should be effected (say) after every three tests. It is advisable to renew the copper oxide after (say) thirty tests.

Although the written description of the test, as above, is somewhat lengthy, it should be remarked that a test may be carried out in thirty minutes by an operator used to this method.

A series of tests were undertaken to allow of making a direct comparison of the nitrogen by difference after complete analysis with that obtained by the copper oxide method; and the results are embodied in the following table:—

No. of Test.	Nitrogen by Difference.	Nitrogen by Copper Oxide Method.	No. of Test.	Nitrogen by Difference.	Nitrogen by Copper Oxide Method.
1	36·06	36·5	16	10·83	10·9
2	26·32	27 08	17	6·88	6·5
3	15·32	14·6	18	6·60	6·4
4	10·0	9·1	19	4·65	3·5
5	8·17	9·4	20	4·32*	3·7*
6	4·22	5·3	21	5·40*	2·7*
7	9·48	8·9	22	3·67*	2·5*
8	6·78	5·5	23	3·42*	2·5*
9	5·4	5·8	24	4·23*	3·6*
10	3·98	5·1	25	3·39	3·2
11	4·0*	2·8*	26	4·45	4·6
12	3·52	3·1	27	8·06	8·0
13	3·58	3·8	28	6·22	5·7
14	5·98	5·8	29	6·96	8·4
15	7·7	7·8			

In some of the above cases, the gases were specially produced in the experimental works for the purpose of obtaining abnormal proportions of nitrogen. It is seen that in the examples marked

by asterisk the nitrogen found by the copper oxide method is lower than that determined by difference after complete analysis. These particular gases were of high quality; and the quantity of methane found was greater than usual. It is impossible, however, at this stage to discuss the influence of the intensity of the explosion upon the volume of residual nitrogen, as the inquiry into this matter is incomplete. It is certain that, with gases of normal and low qualities, the nitrogen found by the copper oxide method agrees with that obtained by difference. Experience shows, however, that the nitrogen by difference forms no absolute criterion from which to judge the degree of reliability of any nitrogen test.

Messrs. Townson and Mercer have undertaken to manufacture this apparatus in the future.

STATUTORY GAS LEGISLATION AND MODERN REQUIREMENTS.

By Norton H. Humphrys, Assoc.M.Inst.C.E.

III.

I will now proceed to notice the necessity for a revision of the principal clauses in the Sales of Gas Act, 1859, and the objectionable features as regards the rights of the seller, bearing in mind the point raised in the previous article—that a consumer who obtains more gas than he pays for, although nominally securing the extra gas at the expense of the seller, practically does so at the cost of the other consumers.

> The rules for testing meters are specified in section 13: "Firstly, the meter should be tested for soundness or leakage only, and not for percentage of error, when fixed on a horizontal base, and with gas under the pressure of a column of water three inches high, with a light or lights consuming not more than one-twentieth of its measuring capacity per hour marked thereon, nor less than half a cubic foot per hour for all meters of a measuring capacity not exceeding 100 cubic feet per hour, and not more than one-fortieth of its said capacity per hour for all meters of any greater measuring capacity than 100 cubic feet; and all meters found to work under such test should be deemed sound meters."

The interesting point about this provision is the limit at which a meter does or does not work. So far as the sale of gas is concerned, the 3-light meter, nominal capacity 18 cubic feet per hour, may be regarded as the minimum, and it will be observed that the 5-light and the 10-light nominal capacity, 30 and 60 cubic feet respectively, also come within the one-twentieth limit. And probably more than 50 per cent. of the total quantity of gas consumed passes through meters of these sizes. Take the 10-light as an example, because it is the size in most general demand. The limit for testing may be anything up to 3 feet per hour. It is not very clear why the limit should be put in the form of a maximum and minimum; but as it stands the operator can use his judgment and pass anything between ½ and 3 cubic feet. And it is obvious that the lower the quantity passed, the nearer will be the approximation to that indefinite point at which a meter ceases to "work." For our purpose, it is necessary to consider the maximum that may take place under the Act; and this may be in the neighbourhood of 2½ cubic feet, because it could reasonably be claimed that the meter "worked" if it indicated only ½ cubic foot per hour.

At this point it is necessary to discriminate between leakage and short measurement, which are two very different qualities. A meter may be reported as 5 per cent. slow, and the defect may be due to (*a*) leakage through the valves from inlet to outlet, or (*b*) to the measuring chambers not expanding properly. A defect of the nature of (*a*) will be practically a constant quantity—always going on as long as the meter is charged with gas. The practice of shutting off the meter at the main tap has gone out of use with the constant demand for gas, and the use of flash-lights is very general. So it is not unreasonable to assume that the meter may be in use for 8000 hours per annum; and at 2½ cubic feet per hour, it may pass in that time 20,000 cubic feet of unregistered gas. This is quite independent of the quantity registered, and paid for, which in a meter of this size may be anything from 50,000 cubic feet up to 200,000 cubic feet per annum. A meter that passes the test for soundness may lose the company nearly one-half of the total quantity consumed in the case of a small regular consumer, or in the case of a "stand-by" the whole. There are many of this class who do not use enough to make the meter work. An important point in connection with the question of leakage is the extensive use of small-rate burners, such as the No. 0 or No. 1 Welsbach. A "sound" meter, according to the Act, may supply two such burners gratis. Losses of the class (*b*) would be only a percentage on the actual consumption (say, 2500 cubic feet to 7500 cubic feet); and it is important to observe that only loss of this nature appears to be contemplated by the Act.

The modern conditions of gas supply and consumption tend to enormously increase the risk of loss due to causes coming under class (*a*), and gas suppliers are entitled to stringent regulations as to the soundness test that will at least reduce and minimize this risk. Apparently, the pressure named was supposed to be an excessive one compared with that obtaining in ordinary practice. Since 1859, the average pressure at the meter inlet has certainly more than doubled, perhaps it has increased threefold; and for this reason alone the pressure for the soundness test should be more like 100-10ths than 30-10ths. Apparently the only reason for passing gas during the soundness test is to ensure the safety of the operator, who tests round the seams with a light. It would be just as easy to make a test with the outlet soundly plugged. The use of a light is only required as a means of locating the leak. It is only right to say that meter-makers have risen to the occasion, and sought to supply an article suited to modern requirements, rather than a bare compliance with the Act.

So far we have been considering leakage through the outer case of the meter; but it may take the more insidious form of leakage from inlet to outlet. This is the more serious because of the difficulty of detecting it; and there is a possibility that it may go on for years, to the benefit of the consumer and with corresponding loss to the undertaking. Already some attention has been given to the subject of passing unregistered gas. It belongs to class (*a*), and is independent of the quantity of gas consumed so long as it remains in excess. It is a first charge, taking effect on every hour that the meter is in use, and calls for stringent measures of a preventive character in the first place, and for full powers of searching inquiry in the second. The suppliers of gas should be able to ascertain, not merely the number of burners in use, and full particulars of the hourly consumption, but also the habits of the household as affecting the hours of burning. Comparing the gas consumption with the corresponding quarter for previous years is to some extent a check, but is not a complete or satisfactory one. There are many other causes besides the general change from the flat-flame to the incandescent burner that tend to upset it; and the usual experience is that the consumption now varies year by year from so many different causes, that the comparison is not so useful as when the consumption ran along steadily year by year. A somewhat homely, but none the less efficacious, method of detecting unregistered gas is the method known as the one-light test, which is particularly applicable to small household systems. In an extensive system of piping, there may be sufficient leakage to upset it. Assuming all the lights are turned off, and that the fittings are sufficiently sound, a test-burner, with regulator set to a consumption of (say) 5 cubic feet per hour, is attached to the nearest fitting. The time occupied in passing one cubic foot on the test-dial of the meter is accurately observed, and if the meter is correct should be close to twelve minutes. At present, such a test can only be made by permission of the consumer, as the gas company have no authority to touch the fittings beyond the meter. But it might well be legalized.

It is worth while to observe, before passing on to consider the accuracy test, that while the seller has to take the risk of all the loss attaching to leakage or unregistered gas, there is no corresponding risk to the buyer. While the seller's loss may be (*a*) a constant quantity per hour, or (*b*) a percentage on the quantity registered and paid for, and possibly a combination of the two, the buyer's risk is confined to class (*b*) only.

The use of the automatic system introduces a third risk of loss, which may be called (*c*), and which may, or may not, exist coincidently with (*a*) and (*b*); that is the loss due to the shut-off not being instantaneous or sound. There is this advantage about the shilling-in-the-slot as compared with the penny meter, that it reduces the number of shut-offs, and consequently the risk of loss from this source. I do not think that this point is generally appreciated. One can understand that it may be possible for a meter set to close after delivering 20 cubic feet, to pass 21 cubic feet before shutting off completely, or even to leave a continuous small leakage due to the valve not seating accurately. The general experience goes to show that the loss on the automatic meter, notwithstanding this additional risk, does not, in practice, exceed that on the ordinary meter; and that so little has been heard about risk (*c*) is a great credit to the manufacturers, showing that, like the manufacturers of gas, they do not need the terrors of legal enactments to force them to turn out a good article. If they were satisfied to abide by the bare provisions of the Act, the result would be very different.

The second paragraph of section 13 specifies: "The meter to be tested for percentage of error should be fixed on a horizontal base, and should be tested at a pressure equal to a column of water $\frac{5}{10}$-inch high, and passing the quantity of gas per hour which should be marked thereon as its measuring capacity per hour." Section 12 provides that any meter not varying from the true standard measure more than 2 per cent. in favour of the seller, or 3 per cent. in favour of the consumer, shall be stamped as correct.

In view of the remarks already made as to the pressure at which the gas actually paid for by the consumer is measured, it is evident that 5-10ths is absurd, not merely as adding 0·5 or so per cent. in favour of the buyer (by no means an inconsiderable item), but because the test obtained at 5-10ths is not to be depended on as representing the working of a meter at 30-10ths or 40-10ths. It should be raised to at least 30-10ths, or, better, accuracy tests might be taken at two varying pressures—say 20-10ths and 45-10ths. Considering that the seller's risk of loss is much greater than the buyer's, he might reasonably claim any advantage in the matter of the turn of the scale. There is no commonsense or fairness in penalizing the gas company because a meter is found to be wrong—a matter beyond their control. The accuracy test, moreover, does not necessarily ensure that the discrepancy is under class (*b*) and is a percentage of the quantity registered. A trifling deficit, well within the limits of correctness but belonging to (*a*), may be a much more serious loss in practice than a very much larger percentage under (*b*). At the best, it is a percentage on the nominal capacity of the meter, which is a

very different thing from the actual average consumption over twelve months. The point in favour of the buyer is a much more serious matter than appears at first sight. If the pendulum was allowed to swing the other way and the limit put at 3 per cent. in favour and 1 per cent. against the seller, the advantage would still be substantially in favour of the buyer.

Section 21 is of an extraordinary not to say absurd nature, and without parallel. The inspector's certificate, if worth anything at all, must be final and binding; and after the company have been to the trouble and expense of obtaining it, common justice demands that it should be so. But the inspector can be required by either party "to give his reasons for such decision," and a further test, to be conducted by two other inspectors, can be demanded. If they do not agree, there may be an appeal to Quarter Sessions. I have never met with an instance of a Judge at Quarter Sessions being called upon to decide between two differing certificates, nor does it appear possible that he or anyone else could do so with any certainty. There is no corresponding case in the Weights and Measures and the Adulteration Acts; and the section as it stands is simply a medium to assist an obstinate and unconvinced consumer in putting the company to needless expense or trouble. If a shopkeeper is charged with using light weights, the evidence of the inspector is conclusive; and if the case is proved, he is fined on the evidence. The same under the Adulteration Acts. If the district analyst certifies that coffee or butter is adulterated, there is no appeal. One can imagine the confusion that would arise, and the difficulty of enforcing provisions made for the protection of the public, if the delinquent could demand that his scales and weights should be re-tested by two other inspectors, or the sample of goods analyzed a second time by two other analysts. Possibly he would be led to do so in the hope that some discrepancy would arise between the various tests that would enable doubt to be cast upon the whole, and he would of course claim the benefit of the doubt. If the inspector's certificate is good enough to cover the sale of gas through ninety-nine meters, it should certainly be equally authoritative in respect to a dispute arising over the hundredth. Section 21 should be ruled out and replaced by a statement that a duly authenticated certificate should be binding on both parties, and, if necessary, could be enforced by any of the usual legal processes.

The way in which the average meter is used to-day is not calculated to promote accuracy, or a long working life. Take, as an example, a house in which gas is not used for lighting, but for supplying a cooker, a geyser, and gas-fires. It is evident that the meter gets long periods of absolute rest, and at times is rushed up perhaps to double nominal capacity for a few minutes. Most people turn the tap with a vicious jerk, instead of a slow steady movement. Hence many leaky taps. A tap of any kind pays for gentle treatment. The result of suddenly throwing on the full requirement of a geyser, a gas-engine, or a large technical furnace burner must be to put some strain on the valves and mechanism of the meter.

We take out the consumption per consumer, or per mile of main, and get much useful information thereby. It would be equally advantageous to take out the consumption as a percentage of the nominal meter capacity. It is easy to take out the total by adding the number of each size of meters in use—so many threes, so many fives, tens, and so on. By so doing we can get at the total meter capacity per hour. The hourly output, at different times of the clock and at various seasons of the year, can be obtained by special observation, if not already shown on the works books.

SOURCE OF THE COKING PROPERTY OF COALS

A dissertation by Herren Walther Hempel and F. Lierg, of the Technical College at Dresden, on the Chemistry of the Coking Process, has been published in a recent number of the "Zeitschrift für angewandte Chemie." The authors point out that attempts to establish a relation between the proportions of hydrogen, oxygen, and carbon in coals, and their coking qualities, have failed, because of two coals of almost identical composition one will be a caking coal and the other a non-caking coal. Consequently, theories have been propounded from time to time in which other causes of the coking property have been suggested.

Wedding thought that certain undefined tarry bodies in the coal, on heating to high temperatures, decomposed into volatile compounds and solid carbon, of which the latter separated in a stalactitic or tubular form in which it served to bind together the rest of the coke. Another view is that the carbon of coke is a special modification, which may be regarded as marking a transition stage from amorphous carbon to graphite. Having regard, however, to the wonderful hardness of coke, it occurred to the authors that the silica contained in the mineral matter of the coal might play an important part in the formation of coke. They have made investigations with a view to ascertaining if any relation subsists between the silica in the coal and the coking quality. They remark that the silica in coal partly comes from the vegetable matter from which the coal has been derived, and that it is doubtless in the form of organic silicon compounds. The silica thus finely distributed throughout the coal is reduced in the coke-oven to silicon; and perhaps carborundum and ferro-silicon are formed therefrom. It had previously been observed that similar reduction occurs when a porcelain tube filled with wood charcoal is heated to 950° to 1200° C. It is also known that when carbon is embedded in a mixture of sand and coke and heated to the temperature of formation of carborundum—viz., 1600° to 1900° C.—it undergoes a complete change and acquires the hardness and metallic ring of good coke, as well as the bright gray or polished metal colour. Though it is possible to burn away the carbon and leave the carborundum from a mixture of the two by heating it in a current of oxygen to 900° to 1000° C., the authors were, however, unable to obtain any residual carborundum when coke was burnt in oxygen at this temperature.

They next endeavoured, by complete analysis of coke, to ascertain if any of the silicon were contained in it as silicide. The nitrogen in the coke was determined both by Kjeldahl's method, and by combustion of the coke in pure oxygen with volumetric estimation of the nitrogen in the resultant gaseous products. The latter method yielded a higher proportion of nitrogen than Kjeldahl's. The authors give analyses of four cokes, with the results of nitrogen determinations by both methods, and conclude that the inorganic constituents play an important part in the constitution of coke. They believe that the whole of the iron in the ash of coke is combined with either silicon, carbon, or sulphur, and that a part at least of the silicon is in the form of silicide, and not as silica. The analyses of the four cokes are given in the appended table.

Table Showing the Analyses of Four Cokes.

Description of Coke.	American Coke.	Gas Coke.	Westphalian Coke.	Mexican Coke.
Constituents—				
Carbon . . . . per cent.	85·44	77·08	93·3	87·5
Hydrogen . . . . ,,	0·56	0·47	0·8	0·6
Nitrogen, by oxygen combustion . . ,,	0·64	1·60	0·7	1·3
Nitrogen, by Kjeldahl's method . ,,	0·53	0·79	0·4	0·9
Silicon . . . . ,,	2·07	0·28	0·4	0·2
Iron . . . . . ,,	2·49	1·09	1·8	3·6
Sulphur . . . . ,,	2·03	0·36	0·5	0·8
Ash . . . . . ,,	6·45	18·85	2·3	5·8
Water . . . . ,,	0·49	0·30	0·1	0·1

The authors believe that, by suitable treatment, any coal may be made to yield good coke. They determined the resistance to compression or crushing strength of a number of cokes. The best of these, obtainable in the ordinary way at Dresden, sustained 2050 to 2600 lbs. per square inch. A sample of Buschtehrader coal, containing 4·9 per cent. of ash, yielded a coke which could be readily crumbled in the fingers, but when heated in a crucible, after admixture with other materials in the proportions named below, it yielded a coke which had a crushing strength of 5600 lbs. per square inch, and contained less than 10 per cent. of ash. The mixture was, in parts by weight: Coal, 120; coke from the same coal, 18; clay, 4·8; commercial coal tar pitch, 8—the latter being dissolved in 18 parts of tar from the coal in question. The authors therefore conclude that the quality of coke may be improved by adding clay, tar, and pitch to the coal.

Tar Treatment of Road Surfaces.

A special meeting of the Council of the Roads Improvement Association is to be held shortly to consider the complaints now being made in certain districts that road surfaces constructed with tar or bituminous materials are unduly slippery for horse traffic. According to the facts at present before the Association, it would appear that any slipperiness of the surface of tar-treated roads is due to one of two causes. It is the practice of horse-owners in certain districts to screw calkins on their horses' shoes in wet weather. These chisel-like devices have the effect of penetrating the most efficiently tarred roads, and permit the water to get underneath the tar, lifting it and causing a greasy substance to be formed. The other cause is the application of a medium amount of "topping" and tar when treating a road, which adds to its durability, but causes the surface to have a smooth and asphaltic finish.

Neutral Sulphate of Ammonia.—A German patent has been granted to M. Wendriner in respect of a process for the production of neutral sulphate of ammonia. According to some particulars in the "Chemical Trades Journal," instead of washing the crystals with water or gas liquor in a centrifugal, whereby a considerable proportion of the crystallized salt is redissolved and has to be recovered, the patentee proceeds as follows: A concentrated solution of ammonium sulphate, saturated with ammonia gas, is used for washing. So far from any of the salt being dissolved, its amount is increased by as much as corresponds to the free acid it originally contained. The liquor running away from the centrifugal is not directed towards the saturator as usual, but is collected in a separate vessel, in which it is resaturated with ammonia, and is then used over again. In addition to the advantage attending the production of sulphate absolutely free from acid, and that without re-solution of any portion by the wash-liquor, the use of the method simplifies the whole process of producing sulphate of ammonia; for there is no periodical or continuous addition of wash-liquors to the contents of the saturator, causing alterations in the acid concentration and in the bulk of the contents.

THE CARBONIZATION OF COAL.

By Professor VIVIAN B. LEWES, F.I.C., F.C.S.

[The Third of a Series of Four Cantor Lectures delivered before the Royal Society of Arts, Dec. 11.]

Having gained an idea of the results desired in the manufacture of illuminating gas and furnace coke, we can pass on to the thermal conditions existing during carbonization. At the outset, we are met by the difficulty that little is known as to the heat of formation of coal, and that a variety of opinions exist on this point. It is evident that, as the composition of coal in a mine will vary not only in different seams but even in the same seam, there is no definite composition, and that nothing can be known as to the heat of formation except by direct determination, which necessitates experimental estimations of so complicated a character that the introduction of errors is extremely likely to vitiate the results.

THERMAL REACTIONS DURING DISTILLATION.

Probably the most valuable work done in this direction is to be found in a report presented by M. Euchêne on the thermic reactions which occur during the distillation of coal, which is in the "Transactions" of the International Gas Congress in Paris, 1900,* in which he determines the thermo-chemical data coming into play during the distillation of coal in the manufacture of gas, with careful estimations of the heat of formation of the products of the distillation as compared with the heat developed by the fuel needed for the distillation—that is to say, a balance is struck showing on the one side the heat generated and on the other the heat expended—the difference found representing the heat of the decomposition of coal.

Mahler also determined the calorific value of a coal and of the products obtained on carbonizing it; and both these observers found that the calorific value of the coal exceeded that of the products—that is, that coal is endothermic, and that its decomposition evolves heat. But it is quite clear that, in the determination of a factor of this kind, which is dependent upon the difference between two figures obtained from a highly complicated set of determinations, each with its own source of error, and all tending in the same direction, these will be borne by the resultant; and it is not surprising to find that, with coal of the same type, Mahler found the heat of decomposition to be + 254·83 calories, while Euchêne found it to be + 63·51 calories.

In Mahler's work, the result was arrived at by deducting the heat of combustion of the products from the heat of combustion of the coal, while Euchêne's determinations were obtained by taking the difference between the heat supplied and the heat consumed during distillation; so that the difference between the two would be likely to be increased by errors leading in opposite directions. M. Euchêne has determined in this way the heat liberated during the distillation of three types of coal; these results showing in a striking way that the heat liberated increases in nearly regular ratio with the amount of volatile matter in the coal, and that the more oxygen the coal contains the more endothermic its reaction—a fact which points clearly to its being the oxygen-bearing compounds in the coal which give it its endothermic character. M. Euchêne in his experiments obtained results which may be tabulated as follows:—

Moisture.	Ash.	Carbon.	Hydrogen.	Oxygen.	Volatile Matter.	Heat of Formation. Calories.
2·70	7·06	77·56	4·79	5·94	25·99	+12·39
3·31	7·21	76·00	4·78	6·82	28·30	+35·98
4·34	8·18	72·08	4·78	8·73	32·17	+63·51

It is well known that if a coal be carefully analyzed, and its thermal value is then determined in a bomb calorimeter and compared with the thermal value as calculated from the most generally accepted formula from the analysis, the results will be in very good accord so long as one deals with an anthracite or steam coal low in oxygen content, but that directly there is any large amount of oxygen, and therefore high volatile matter, in the coal, the value as determined rapidly rises above the calculated value. Now, in the calculation it is presumed that all the hydrogen is in combination with oxygen to form water, so that its heating value is lost to the coal; while we know that if coal is decomposed we obtain large volumes of free hydrogen, and that, unless the temperature of decomposition is very low, but little water is formed, and the secondary product (tar) contains most of the oxygen as oxygenated hydrocarbons—that is to say, the complex character of the oxygen compounds in the coal, and the way in which they break up, renders the calculation of thermal value too low. If this were not so, it might be possible to determine the degree of endothermicity of a coal in this way; and it is interesting to see how figures so obtained agree with those put forward by Mahler and Euchêne.

ANALYSES OF COALS.

Brame and Cowan made careful analyses of five samples of dried coal in duplicate; the mean of two analyses of each being taken. Three determinations of the calorific value of each coal in the Mahler bomb were then made; and these being in close agreement, the mean of the three tests was taken in each case.

Analysis of Coals (Dry) and Calorific Value.

Coal.	Carbon.	Hydrogen.	Sulphur.	Ash.	O + N.	Fixed Carbon.	Volatile Matter.	Calorific Value Calculated.	Values Determined.	Difference taken as Heat of Formation. Calories.
A	90·09	3·85	0·77	1·68	3·61	91·48	6·84	8567	8629	62
B	81·02	3·23	0·64	9·50	5·61	80·80	9·70	7527	7713	136
C	87·79	4·09	0·59	3·14	4·39	82·79	14·08	8425	8617	182
D	84·07	4·51	0·68	5·69	5·04	73·81	20·50	8241	8394·5	153·5
E	78·29	4·76	1·48	4·90	10·57	61·10	34·00	7638	8026·5	388·5

Now we know that the heat of formation, as deduced from these figures, will be too high, as the calculation errs on the low side; so that the true heat of formation will be slightly below this value, and we can use this as a rough guide to forming an opinion as to the correctness of Mahler's and Euchêne's figures. Euchêne found that a coal containing 8·73 per cent. of oxygen and 32·17 per cent. of volatile matter had a heat of formation of 63·51 calories (114·3 B.Th.U.); while Mahler for the same class of coal found 254·83 calories (458·7 B.Th.U.). So that Mahler's figure is in accord with that deduced for a coal intermediate between coals "E" and "D," as analyzed by Brame and Cowan, and is probably a little too high.

Constam and Kolbe made a very fine research upon the carbonization of typical English coals in 1909*, and determined their calorific value, and also the calorific value of their distillation products. They found that the value of the coal exceeded the heat value of the products to the extent shown in the following table, in which the heat-balance of the products of distillation of the ash-free and dry coal is given in percentages of the heat value of the coal substance:

Description of Coal.	Heat Found In				Loss of Heat.
	Coke.	Gas.	Tar.	Pitch.	
	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
1 Nottingham, bright	61·3	22·7	8·4	1·6	6·0
2 Lancashire, Trencherbone	61·7	22·8	11·0	1·4	3·1
3 Nottingham, best hard	64·1	20·2	10·0	1·3	4·4
4 Kinneil	62·9	22·0	9·5	2·1	3·5
5 Durham, Low Main seam.	63·7	20·6	9·5	2·2	4·0
6 ,, Hutton	65·3	22·1	7·7	2·0	2·9
7 Yorkshire, Barnsley	70·4	18 3	6·9	1·9	2·5
8 Durham, Ballarat	73 6	18 6	2·5	1·7	3·6
9 Welsh, Nixon's Navigation	76·7	16·9	2·9	1·4	2·1

This shows, as in the other determinations given, that when we get down to a steam coal—*i.e.*, a coal poor in volatile matter and oxygen—its calorific value more nearly approaches that obtained by calculation or by the determination of the heat present in the products.

If we now take the Low Main, Barnsley, and Hutton seam coal, and calculate what the loss of heat shown in the above table amounts to per pound of ash and water-free coal, we obtain the following results:

	B.Th.U. Per Pound.	Loss Per Cent.	B.Th.U.
Low Main	15,392	4·0	615·68
Barnsley	14,792	2·5	369·80
Hutton	15,766	2·9	457·21

The average of these results would be 480·9 B.Th.U. per pound; and if we take this as due to the endothermicity of the coal, the figure agrees with Mahler's determination, and also with that deduced from Brame and Cowan's work.

It seems likely that when the oxygen in the coal falls below 3 per cent., all endothermicity will disappear, or at any rate become negligible; while with gas coals of the type most used in England, containing about 32 per cent. of volatile matter and 7 to 8 per cent. of oxygen, it will approximate to 250 calories or 450 B.Th.U. per pound of coal. But all the evidence as to this property in coal is of an unsatisfactory character.

HEAT USED IN CARBONIZATION.

When a coal is carbonized, it decomposes into gases and vapours, leaving behind the solid coke; and heat is used up in bringing about the change of state. When 1 lb. of coal is decomposed in the retort, the heat used up in the decomposition and distillation amounts to 462 B.Th.U. over and above the heat due to endothermic reactions. The heat withdrawn from the retort by the hot gas and vapours amounts to 324 B.Th.U., and the heat in the red-hot coke when drawn accounts for another 442 B.Th.U. So that the heat that has to be actually supplied for the carbonization is 462 + 324 + 442 = 1228 B.Th.U. The losses in the setting, however, exceed this, and in an ordinary horizontal bench would be: 1463 B.Th.U. escaping with the flue gases, 398 B.Th.U. lost to the air by radiation and convection, and 23 B.Th.U. in the ash—making in all 1884 B.Th.U.

The thermal value of the reactions in the retort will remain the same whether the distillation be carried out in a horizontal, vertical, or inclined retort, or in a coke-oven or a chamber; and it is chiefly in the setting that the economies have been made which have reduced the carbonizing fuel to the figures attained in

* See "JOURNAL," Vol. LXXVI., pp. 1080, 1141, 1900.

* See "JOURNAL," Vol. CVII., p. 698, 1909.

modern practice. In the horizontal retort-setting quoted above, the total heat used would be 1228 + 1884 = 3112 B.Th.U. Now, 1 lb. of gas coke gives an average of 14,200 B.Th.U. in its combustion, so would give enough heat to carbonize 4·5 lbs. of coal, or, in other words, the coal would require 21·9 per cent. of its weight of coke to carbonize it; while if the whole of the heat of combustion could be used in the retort, 8·6 per cent. would be sufficient. A fair idea of the economies that are possible can be obtained by stating the heat used in the setting and retort in percentages:

		B.Th.U. Per Pound.	Per Cent. of Heat Used.	
Used in retort	1 Decomposition and distillation	462	15·7	39·3
	2 Escaping in gas and vapours	324	10·4	
	3 In hot coke	442	13·2	
Used in setting	1 Flue gases	1463	47·2	60·7
	2 Radiation and convection	398	12·8	
	3 Ash	23	0·7	

So that 39·3 per cent. of the heat is used in the retort, and 60·7 in the setting; the item which overshadows all others being the 47·2 per cent. escaping up the chimney in the hot flue gases.

It is evident that the first step towards economy is to be found in a better utilization of the heat in the setting, so as to abstract, as far as possible, the heat from the products of combustion. This is done by regeneration, which reduces the flue gases by over 300° C. in temperature, and brings down the loss due to this item from 47·2 to 25·2 per cent.; while feeding the producers with red-hot coke from the retort effects a further economy, with the result that the fuel used falls from 21·9 to 14·8 per cent., and even lower. Under these conditions, the percentage of heat used in doing the work of carbonization would be largely increased; and the chart would be as follows:

		Per Cent. of Heat Used.	
Used in retort	1 Decomposition and distillation	21·4	54·1
	2 Escaping in gas and vapours	13·8	
	3 In hot coke	18·9	
Used in setting	1 Flue gases	25·2	45·9
	2 Radiation and convection	19·9	
	3 Ash	0·8	

So that over one-half the heat is utilized in work.

In the most modern practice, results as low as 10·24 per cent. of the weight of the coal carbonized have been quoted; while in vertical retorts and chamber carbonization 12 to 15 per cent. is the usual figure. These advances are made by utilizing hot coke in the producers, more perfect regeneration, and the reduction of the radiation.

Transmission of Heat in Retort-Settings.

The factor which endows all carbonization problems with especial difficulty is that we are dealing with a body of such varying composition that no two samples are alike, while the conditions under which we are decomposing them vary from minute to minute. The conduction of heat through a substance like the walls of a fire-clay retort is a determination fraught with many troubles, as the conditions existing in a retort heated in a bench are totally different from those that can be obtained in making experimental determinations in a laboratory. In any calorimetric determination, the one side of the test-piece is continuously cooled by the calorimeter, while the heat poured into the other side is very different in effect from the mass of heated material existing in the flues surrounding the working retort.

The rate at which heat is transmitted under working conditions depends upon the degree of heat in the flue and outer walls of the retort, the higher the temperature the more rapid being the transmission, while the difference between the temperature of the outer and inner skin of the retort is a factor of the greatest importance. The greater the difference—*i.e.*, the cooler the inner skin and the mass in contact with it and the hotter the outer skin in the flue—the more rapidly will the heat pass. Again, the rapidity of transmission varies with the character of the fire-clay, with its porosity, and with the temperature and length of time for which it has been baked; so that it is impossible to give any definite figure as to the rate of conductivity or transmission which shall hold good in all cases.

Determinations based upon the rate of transmission at comparatively low temperatures may be discarded at once as valueless. Dr. Beilby, however, determined the conducting power of fire-brick, and came to the conclusion that one square foot of fire-brick, one inch thick, passed 6·59 C. pound units, or 11·86 B.Th.U., per hour for each 1° C. of difference between the sides of the brick, when these differences were of the magnitude of 200° to 300° C. S. Wologdine has also determined the rate of conductivity of fire-clay, and finds that the heat transmitted through a thickness of 1 metre across an area 1 square metre per hour for a difference of 1° C. varies from 1·07 calories when the clay has been baked at 1050° C. (1922° Fahr.) to 1·81 calories when the clay has been baked at 1300° C. (2372° Fahr.); and that the diagram connecting fall in temperature with thickness of material is a straight line.

My own opinion is that, at the ordinary working temperature of a retort under gas-works conditions, the amount of heat transmitted approximates to 25 B.Th.U. per square foot of surface for each 1° C. difference in the temperature of the outer and inner surfaces of the retort, and that this is not seriously affected by the thickness of the fire-clay, as conduction is so slow with a retort 3 inches thick that it is probably only the internal portion that is cooled to any great degree when a fresh charge is fed into a properly-heated retort, and the mass of the fire-clay acts as a store of heat, so that the heat has only a short travel.

In a horizontal retort ready for charging, the temperature of the inner walls will approximate to 1000° C. (1832° Fahr.) and the flue temperature to 1100° C. (2012° Fahr.); and the fire-clay walls of the retort will conduct the heat at a rate which approaches to 25 B.Th.U. per square foot per hour for each 1° C. difference in the two surfaces. So that during the first two hours, when the average temperature of the inner side of the retort walls, cooled by the charge and by the retort having been opened, will not be more than 800° C. (1472° Fahr.), the amount of heat passing through the walls into the charge will be 25 × (1100 − 800) = 7500 B.Th.U. per square foot of surface; while by the fifth hour, when the inner side of the wall of the retort has risen to 950° C. (1742° Fahr.), the amount passing will be 25 × (1100 − 950) = 3750 B.Th.U., or only half the amount passed in the earlier period. The average is, therefore, approximately 5625 B.Th.U. per hour, which, taking the heat units needed for the actions taking place in the retort as 1228 B.Th.U. per pound, gives a carbonizing value for a six-hour charge of 12 tons per 1000 square feet of retort surface.

The diminution in the quantity of heat passing through the walls of the retort during the last stages of carbonization does not affect the rate at which the still uncarbonized core of coal is being heated, as the envelope of coke surrounding it has reached nearly the same temperature as the walls of the retort, and forms a store of heat; while in the carbonizing mass the volume of gas evolved during the first part of the distillation is so large that it carries off from the contents of the retort a large proportion of the heat, and so keeps down the temperature of the mass until the later stages of the carbonization.

Carbonization Temperatures.

It has become the custom to speak of the temperature of carbonization being high merely because the temperatures in the flues and in contact with the walls of the retort are high, and to speak of the products of high temperature distillation as if the coal had been carbonized at the temperature existing on the retort surface. It is quite clear, however, that, coal being a bad conductor of heat and coke a worse one, it is only the layer of probably less than an inch thick that is carbonized at anything like the retort temperature. The remainder of the charge is distilled at a slowly rising temperature, which attains its maximum only after the volatile products have been practically all driven off.

The real distinction between high heats and lower flue temperatures is that the higher the temperatures employed, the thicker and hotter will be the layers of coke which the gases and vapours have to traverse in their escape from the inner portions of the charge, and the greater will be their exposure to radiant heat and contact with the highly-heated surfaces of the retort in their outward passage from the carbonizing mass. The products of the primary action are, in fact, being subjected to secondary decomposition under conditions we neither know nor can control; and this is one of the weakest points in our methods of carbonizing for the production of illuminating gas.

We make elaborate tables of the composition of gases and tars produced at various distillation temperatures; but the only information that they give us is what is left undecomposed under unknown and varying conditions. The only certain factor is that the heat is nowhere above that which we are pleased to call the temperature of distillation. It is evident that if these variations exist in the temperature at which the coal is distilling in the comparatively small charge in the gas-retort, they must be accentuated when one comes to deal with carbonization in bulk as practised in oven and chamber settings, as not only is the travel of the gases and vapours through the red-hot coke much longer, but the rate at which the heat is conducted through the carbonizing mass becomes slower as the bulk of the charge increases; while the temperature in the crown of the oven during the first half of the time is higher than is found in the gas-retort. This also applies to the temperature in the top layer of the coke.

If the coal is carbonized in a 6-inch diameter tube filled so that the heat shall be penetrating from every side, there is an almost immediate rise in temperature throughout the mass, owing to the hot gases and vapours passing through the interstices between the pieces of coal, and the coke produced attains its maximum temperature at the rate of about one inch per hour; so that in (say) three hours, with a wall temperature of 1000° C., the centre of the mass would be at about 950° C., and the carbonization of the coal would be finished. If, however, the tube be increased to about 12 inches in diameter, the rate of heat conduction is reduced to 0·5 inch per hour; and the same thing takes place with a flat chamber retort heated from the sides. So that it would take about twelve hours to complete the carbonization; while with further increase in the width of the chamber, the rate of travel of the heat grows still less—the passage of the heat being still slower as the distance between the walls of the chamber gets greater. The result of this is that in bye-product recovery coke-ovens and in large chamber retorts the period of carbonization becomes very long, and the gas has to pass through so much hot coke that the illuminating power is reduced to 9 or 10 candles.

These rates of passage of heat apply only to vertical retorts

or to chambers the sides of which are heated, as bottom heat penetrates the mass rather more quickly, owing to convection coming to the aid of conduction, and the upward flow of heated gases raising the temperature in advance of the conducted heat. Moreover, the rate at which the heat travels in the carbonizing mass depends to a great extent on the initial temperature employed; the figures given being attained only when the flues and outer walls of the retort or chamber are heated to about 1100° C. (2012° Fahr.). But if the flue temperature is lowered, the transmission of the heat becomes lower, and a longer period therefore is required for the complete carbonization—the time taken being nearly inversely proportional to the temperature. So that if in a 6-inch tube with a wall temperature of 1000° C. (1832° Fahr.) it takes three hours to complete carbonization, it would take six hours to do the same work with a wall temperature of 500° C. (932° Fahr.). Consequently, in making low temperature coke, such as coalite, in tubular retorts of 5½ to 6½ inches diameter, it takes four hours to drive off two-thirds of the volatile matter that is in the coal.

The temperature of the coke or coal through which the gas and tar vapours have to pass, and the length of travel they have to reach the exit from the retort or chamber in which carbonization is proceeding, are two of the most important factors in determining their decomposition, as it is these which give rise to the secondary reactions that largely determine the final composition of the gas and tar. Valuable pyrometric observations on the temperatures existing in charges of varying size have been made by Mr. Bond, of Southport, and other observers, from whose work we can deduce the following results as typical.

If an ordinary Ω-shaped horizontal retort, 18 in. to 20 in. wide and 15 in. high, has a 6-inch charge fed into it, the space from the apex of the crown to the top of the charge will be 9 inches deep. If, now, thermo-couples properly protected are placed (1) at the bottom of the charge, (2) in the centre, and (3) at the top, we can gain a good idea of the way in which the heat is acting on the coal. With full heats the coal at the bottom of the retort rapidly heats up, and in fifteen minutes has reached 700° C. (1292° Fahr.), after which its rise in temperature slows-down, and it takes two hours to reach 800° C. (1472° Fahr.) After this, it heats more rapidly and attains 1000° C. (1832° Fahr.) at the end of four hours. Then there is practically no rise in the last two hours of carbonization. The temperature at the top of the charge rises more slowly, and by the end of the second hour is only 740° C. (1364° Fahr.), or 60° cooler than the bottom; and it remains at a lower temperature throughout the whole carbonization. This is not to be wondered at, as although the top flue of the setting is 1150° C. (2102° Fahr.) and the bottom flue barely 1100° C. (2012° Fahr.), the coal at the top of the charge is being heated largely by radiant heat acting across a considerable gas space, while the bottom of the charge is in direct contact with the heated bottom, and is taking in heat by conduction.

The thermo-couple in the centre of the charge throws most light upon the course the distillation is taking; and we discover that, so great is the heating effect of the gases and vapours passing up from the hot zone at the bottom of the retort, at the end of the first hour the temperature is only 30° below that of the bottom, 730° C. (1346° Fahr.), while in two hours it is at the same temperature, and then falls slightly below it for the rest of the time—the rush of hot gases from the bottom having ceased, and the temperature of the top of the charge equalling the centre only after the fourth hour.

Now the fact that differences in temperature are so small throughout the mass, and that during the whole of the period when the bulk of the gas is being evolved the centre of the charge is hotter than the top, points to the gas forcing its way through the pasty mass of distilling coke upwards into the space below the crown of the retort, where it is baked by radiant heat from the mass of fire-clay at 1050° C. (1922° Fahr.); and the retort walls at 1050° C. and the coke at 700° to 1000° C. (1292° to 1832° Fahr.) are also in surface contact with it. The passage of the gas through the pasty coke causes considerable swelling during the first four hours of distillation; and when the shrinkage in the charge of coke takes place during the last two hours, the top portion (presumably carbonized by radiant heat from the top of the retort) shrinks over a smaller depth than the bottom and large portion. Thus when the charge comes to be drawn, there is found to be a fissure running horizontally between the upper and lower portions but nearer to the top, from which vertical cracks branch to the top and bottom of the charge.

We are at present dealing only with the thermal conditions existing during carbonization; but when we come to study the more chemical side of the actions taking place, we shall see that such methods are the most brutal form of distillation. High heats and small charges certainly mean high makes of gas, but got at the expense of all the other bye-products, and bringing in their train all the troubles of stopped ascension pipes, carbonized retorts, ruined tar, and poor coke. If, instead of using a 6-inch charge in such a retort it be filled with coal as nearly as a horizontal retort can be filled—that is, to within 2 or 3 inches of the apex of the crown of the retort—and the same temperatures as before are used in the setting, we approach the conditions that obtain in vertical retorts, which are entirely filled, and quite different results are secured. These improved results are by most observers ascribed to the doing away with the baking chamber above the charge—radiant and contact heat being credited with the formation of free carbon and naphthalene, which have been the chief curses that have accompanied the raising of temperatures with small charges to increase the gas volume obtained.

The Passage of Gas in Full Retorts.

The determination of temperatures as before in the charge shows that filling the retort does much more than this, however. In the first place, in order to properly carbonize the charge, the heating has to continue from eight to twelve hours instead of six; and the heat is poured into the charge in a much more even manner. The rise in temperature at both the top and bottom is equal throughout the distillation, and with the top temperature always about 100° C. more than the bottom—truly reflecting the difference in temperature between the top and bottom flues of the setting. Owing to the thickness of the charge having been doubled, the heat advances more slowly into the mass, rendering the coal semi-fluid and pasty in front of it, and so forming the whole centre of the charge into a tube, through which a large proportion of the gas finds its way down to the mouth of the retort without having been overheated in the crown.

That this is the true explanation is shown by the thermo-couple in the centre of the charge, which during the first 5½ hours of the distillation rises slowly in temperature at about the same rate as the outer portions, but on a plane some 500° C. (932° Fahr.) below them; while after this period, the central heat rises rapidly, and the same temperature as exists at the bottom of the charge is attained in the eighth hour. The gas is improved because only a small portion has to run the gauntlet of overheating; the tar is improved because a considerable proportion is made at a lower temperature; the coke is improved because in the earlier half of the distillation a good deal of tar has condensed in the cool zone; and as the temperature rises the more volatile portions re-distil, but the least volatile remain and get decomposed only in the last hour of carbonization, and increase the gas yield—the factor for which the gas manager at the present time seems prepared to make any sacrifice.

It must be clearly borne in mind that the possibility of filling a horizontal retort to within 3 inches of the crown, though suggested by Kunath in 1885, is a comparatively new condition, which could be achieved only by the introduction of some discharging machinery that would push the charge of coke out of the retort, and that as long as we were dependent upon hand labour to draw the charge it was impossible. Now, however, the introduction of vertical settings allows a more complete filling of the retort by gravity and easy discharge; so that the question of the route taken by the gas in its escape from the carbonizing mass is receiving its full share of attention, and opinions on the subject are by no means unanimous.

Dr. Bueb, to whom we owe the inception of the Dessau vertical retorts, is strongly of opinion that the largest bulk of the escaping gas finds its way through a cool core in the same way that it undoubtedly does in a well-filled horizontal retort; others favour the theory that the major portion passes up the sides; while Dr. Harold Colman and many others agree that as the pasty area of the decomposing coal works its way inwards from the walls of the retort to the centre, gas escapes on both sides of it, so that a portion goes up the centre and the remainder through the hot coke or up the walls of the retort. What proportions exist between the gas that takes the cool route and that which is forced to pass through the hot coke cannot be exactly determined, and would vary with each kind of coal. But what we do know beyond doubt is that a great volume of the richest gas comes off from all coals when first heated; so that a large evolution of primary gas will be on the inside of the tube of semi-fused coal. Another factor which would tend to make the gas take the inner route is that any passing back into the hot zone would be expended by the temperature, while the still pasty coke would offer more resistance to the passage of the gas than the coal, so that pressure would be highest on the hot side and lower on the cool side; the probabilities therefore being that, as long as the central passage is unimpeded, the major portion of the gas passes up the centre. The analyses of the gases, however, all show that far too much cracking of the rich hydrocarbons has taken place.

I have had considerable experience in carbonization in vertical 5½-inch to 6½-inch tubes at all temperatures, and find that for a considerable period the gas escapes freely up the central core. But a time soon arrives with a column of this thickness in which the least volatile constituents of the tar condense in the central core, and so choke it that the pressure rises to an undue degree in the lower half of the tube, and causes serious leakage at the bottom door of the retort; while some gas and tar vapour are forced from the lower half of the charge through the already choked portion and along the walls. As pressure is the most fertile source of carbon deposits in a retort, this is a serious consideration.

When we are dealing with a well-filled horizontal retort, we have an oblong mass of coal, 18 or 20 inches wide by 12 inches thick, and the heat advances so slowly that there is but little fear of choking from tar until the distillation is practically nearly completed. The same thing will be found with chamber retorts, such as have been installed by Mr. Thomas Glover, at Norwich. The latter consist of oblong retorts, 3 feet high, 1 foot wide, and 21 feet long, taking 21 cwt. of coal as a charge, which requires twelve hours for its proper carbonization. In these chambers, the course of the heat is manifestly inwards from the sides, which constitute the largest heating area—this being shown by the fracture of the coke on drawing being vertically down the centre.

It has been seen that, with the horizontal retort, the coke on drawing has a horizontal fissure or fracture through the mass—the heat having passed into the charge chiefly from the top and bottom. The fracture in a coke charge is due to tar distilling forward before the advancing heat in the charge and portions condensing at the coolest spot, to be afterwards re-distilled as the heat reaches that area of the charge. This takes place during the last two hours of the carbonization, during which time the remainder of the coke is contracting and becoming denser under the prolonged action of heat, which shows itself by the charge shrinking from the walls and also from the still soft central layer leaving the fissure in the finished coke. When the carbonization is carried out in a tube, the fissure becomes a hole in the centre of the rod of coke—the sides of the hole showing ample signs of the carbonized tar; while if forced from the tube two hours before carbonization is completed, the core is found to consist of coal and soft pitch.

In coke-ovens, in which a large mass of coal is heated from the sides, the fissure (or plane of separation, as it is best called, to distinguish it from the planes of cleavage, which, as a rule, are nearly at right angles to it) is vertically down the centre when the oven has been properly heated and the two sides are at the same temperature. But if the two sides are not at the same temperature, the plane of separation is found nearest to the cooler side.

Swelling Coal—A Low Temperature Trouble.

There is a wide difference between coals of very much the same ultimate composition in the way in which they are affected by heat during carbonization; and the value of the coke produced will largely depend upon the conditions of carbonization being made to fit the behaviour of the coal—a point to which sufficient attention has not yet been paid in the manufacture of coal gas. This has made itself felt in the introduction of the vertical retort, in which it is found that certain classes of coal give rise to undue swelling of the charge in the earlier stages of carbonization, and so lead to the choking of the top of the retort. When horizontals with a 9-inch space above the coal were used, it did not matter how much or how little the coal swelled; but with a completely filled vertical retort, it becomes a serious matter.

The swelling of a coal during destructive distillation is largely dependent upon its degree of fusibility. If a coal fuses easily and the products are fairly liquid, the gases escape from it readily by the bursting of the tar bubbles formed; and the swelling is but slight. So, also, infusible coals, which undergo but little softening, give no trouble in this respect. But coals which yield a tough, viscid mass form large bubbles and give rise to troublesome swelling. This shows itself even more with low temperature carbonization than with high heats, and was one of the factors that gave serious trouble in the manufacture of coalite.

Secondary Reactions.

In the manufacture of coal gas in lightly charged horizontal retorts, not only does the length of travel that the escaping gases have to undergo through red-hot coke vary through the whole process, but the length of time they are exposed to radiant heat in the crown of the retort, and the amount of contact with the highly-heated fire-clay surface, also vary to an extent that makes any uniformity of action or result an impossibility.

The products of distillation from the coal near the mouth of the retort—be it horizontal, vertical, or sloper—have only a short travel to reach the mouthpiece, and are hurried on by the gas behind them; so that the time given for secondary reactions is curtailed to a fraction of a second, while the gas from the end of the retort has nothing to drive it forward, and has to run the gauntlet of surface action and baking to an extent that results in little else than hydrogen and carbon. Between these two limits every degree of secondary reaction is to be traced, and the gas and tar obtained are a mixture of the results of everything from low temperature distillation for a short period to high temperature for a long period. The temperature of the gas as it reaches the mouthpiece of the retort shows but little of these variations in individual portions of the gas, as they are going on *pro ratâ* throughout the whole time of carbonization, and the thermo-couple or thermometer registers merely the mean temperature of the volume of escaping gas. So that as the period of carbonization proceeds, and the bulk of distilling vapours and gas grows smaller, the temperature of the escaping products grows less, although coming from a mass at a higher temperature.

It will be found that, at the usual carbonizing heats, as soon as the gas begins to escape freely, the temperature at the mouthpiece will be approximately 400° C. (752° Fahr.), and that this will remain fairly constant until the fifth hour; while the falling off in volume during the fifth and sixth hours is reflected by a gradual fall in temperature of about 100° C. (180° Fahr.). As might be expected, the slowing-down of the rate of flow of gas and vapour is shown even more by the temperature at the top of the dip-pipe, which rises with the first rush of gas to 120° C. (248° Fahr.), and then steadily falls to about 50° C. (122° Fahr.) by the end of the period of carbonization.

In the secondary reactions taking place in the retort, pressure plays an important part; and as pressure is being created constantly by evolution of gas, expansion, and decomposition, the maintenance of an even pressure is a matter of great difficulty. Where the dip-pipe and hydraulic main are used, although the retort-house governor may keep the pressure steady in the hydraulic main itself, the escaping gas will be subjected to throbs of pressure as the gas forces out the liquid in the dip and escapes into the hydraulic main. When the gas is escaping rapidly, these changes of pressure succeed each other so rapidly that the effect in the retort is a pulsation, while as the flow of gas slows-down the individual throbs become more and more distinct; and, short as their duration may be, they add not only to leakage but also to decomposition.

Size of Coal.

In many works little or no attention is paid to the size of coal used. The coal as it comes from the truck, barge, or ship goes into the retort—only the lumps so large as to give trouble being broken; and it is manifest that the flow of heat into the mass must be considerably affected. Indeed, in the manufacture of furnace coke, uniformity in the size of the coal is looked upon as being as important as the amount of moisture and other factors of the same kind. It is clear from these considerations that in the destructive distillation of coal for the manufacture of gas there is no one factor of uniformity in any part of the process, and that to attempt to trace the course taken in the decomposition of a body of unknown structure like coal under such conditions is not likely to meet with much success.

Small Quantity Research and Working Conditions.

Many observers have attacked the problem of distilling coal at various temperatures, analyzing the resulting products with commendable care, preparing curves of convincing character, and launching forth on a sea of theory and conjecture, apparently oblivious of the fact that in each experiment, supposed to represent the changes at the particular temperature employed, they were dealing merely with a trace of those particular products diluted with every primary and secondary product formed at all temperatures below it. Some of these researches, like those of Mr. Lewis T. Wright (made, as they were, on working charges under working conditions in ordinary gas-works plant), are of the greatest possible value, as they represent what actually takes place in gas manufacture with all its varying conditions, and are a contribution to our knowledge of an importance that cannot be over-estimated; but the class of research that deals with gramme weights of material carbonized under conditions that never have been, and never can be, attained in practice are of little interest, even from a scientific point of view.

It is clear that to obtain any insight into the actions taking place in the destructive distillation of coal, the quantity and composition of the tar are quite as important as the volume and composition of the gas; and a knowledge of the composition of the coke is also essential. Long ago it was recognized by the gas manager that the small coal-testing plants in which 2·2 lbs. of coal were distilled gave results which did not agree with the works' practice; the yield of coke on the small scale experiment being too low, and the tar too high, while the gas was generally higher in candle power. This is due to the whole mass rapidly heating-up and the tar vapours distilling out without there being any cooler portion of the charge for them to condense in, so that they yield the minimum of pitch and carbon to the coke, while the gas has but little surface contact to degrade it. Constam and Kolbe found that, using 1·1 lbs. of coal, the yield of coke was 2·7 per cent. lower, and the tar 1·6 per cent. higher, than the results given by the same coal when used on a large scale.

When, however, one comes to the use of 2 grammes of coal, as has been done by some recent investigators, the results obtained are ludicrously wrong—a Silkstone coal being credited with yielding 16·2 per cent. of tar at 750° C., or over 30 gallons, and 10·9 per cent. at 1050° C., while at 450° C. it yields only 4·29 per cent. In actual practice, we know such a coal yields at 1000° C. about 10 gallons, and at 450° C. about 22 gallons of tar. The views I shall have to bring before you in the next lecture are based upon the carbonization of some thousands of tons of coal at low temperatures; and I think they afford fairly clear evidence of the actions taking place.

Professor Lewes on the Carbonization of Coal.—At the Royal Society of Arts last night, Professor Vivian B. Lewes, F.I.C., F.C.S., delivered the last of his series of Cantor Lectures on the carbonization of coal. He directed the attention of his audience to the possible improvements in carbonization, compared the intermittent with the continuous vertical retort, pointed out the characteristic features of the Settle-Padfield, Woodall-Duckham, and Glover-West systems, and indicated the ends to be kept in view in devising new processes of carbonization. A report of the lecture will be given next week; and the entire course will appear in the "Journal" of the Society during the Christmas recess.

Determination of Nitrates in Water Analysis.—In the "Chemical and Biological Survey of the Water of Illinois," Bulletin No. 7 of the University of Illinois," there is an article on the determination of nitrates in drinking water. It is the outcome of a comparison of various methods for the determination of nitrogen as nitrates. The "Chemical Trades Journal" gives the following as the summarized conclusions of the research: Because of loss of ammonia, the amount of ammonia recovered in a given time in open reduction tubes varies inversely with the temperature. The loss of ammonia is prevented, and the temperature has no effect, if the hydrogen is allowed to escape through traps. The reduction is completed in less than four hours in pure water or waters of average purity; in highly-polluted water, the reduction requires a longer time.

HOT WATER.

By S. A. Carpenter, of Hendon.

[A Paper read before the London and Southern District Junior Gas Association, Dec. 15.]

The question of the domestic hot water supply is becoming a more important one each year, and no new house would now be considered complete unless some system for providing a supply of hot water in the bathroom and scullery was installed.

The coal-range boiler, placed at the back of the kitchen fire, has commended itself to the builder by reason of its cheapness; but in action it is not entirely satisfactory. With a brisk fire, the water boils; and if the water is hard, a rapid incrustation of the boiler and adjacent pipes takes place, which quickly lowers the efficiency of the apparatus, causes leaks, and sets up explosion risks. The temperature of the heated water varies greatly, depending as it does entirely on the state of the fire. Apart from these drawbacks, the almost universal use of the gas cooking-stove leaves the coal-range—at any rate, during the summer months—unlighted, and therefore useless as a producer of hot water; and some form of gas-boiler becomes a necessary adjunct to the gas-cooker.

Architects are beginning to appreciate this; and there is a growing tendency to leave out the coal-range entirely, and to instal instead a gas-heated circulator and cooking-stove. It is true that there are also electrical water-heaters on the market; but the low heat value of the electrical current makes it unnecessary to seriously consider these. If we take the heat equivalent of an electrical unit at 3410 B.Th.U. and gas at 500 B.Th.U. per cubic foot, with the former at 1d. per unit and gas at 3s. 4d. per 1000 cubic feet, we get 12,500 B.Th.U. from a pennyworth of gas, compared with 3410 B.Th.U. from the corresponding amount of electricity.

The gas-heated apparatus has many advantages, among which are the quickness with which the water can be heated, the ease with which a given temperature can be maintained, lack of incrustation in pipes, and adaptability for the immediate production of either large or small quantities of hot water at any time of the day or night.

We may roughly divide water-heaters into two types:

1.—Instantaneous heaters, usually known as geysers, in which the entering cold water is split up into fine streams, and spread over as large a surface as possible and brought into intimate contact with the heated surface of the apparatus, so that by the time it reaches the outlet it is hot, and a continuous stream of hot water is obtained. Geysers obtain a high percentage efficiency, especially those of the open type, where the heated products from the burner mix with the falling stream of water. Low flue temperature, and consequent high efficiency result.

2.—Circulators are of two kinds—those which work on the tank system, and those which are on the cylinder system. In the former case, the boiler, which is of small capacity, heats the water and passes it on to a storage tank. On top of this tank is a vent-pipe, or expansion pipe, with open end. This gives a means of escape for air and for steam, should this be generated. From this expansion pipe, the hot-water supplies are usually taken. In the cylinder system, the boiler and storage tank are sometimes combined; and if not actually combined, are placed in close proximity. The expansion pipe starts from the top of the cylinder, and terminates above the cold-water cistern, and all the hot-water branches are taken from it. With this latter arrangement, the loss of heat from the flow and return pipes between the boiler and storage tank is avoided.

Modern houses usually boast a linen cupboard; and the architect is very fond of placing the hot-water storage tank in this cupboard. This appeals to the careful housewife, who often mistakenly believes that the clothes will be kept aired with waste heat from the fire. Where these conditions obtain, the tank system must, of course, be used, though obviously not as efficient for the production of hot water as the cylinder system. With either plan it is possible to obtain a small quantity of hot water quickly, starting from cold.

The author having described in detail many of the well-known types of apparatus, went on to say that nearly all the makes he had considered had some speciality, and remarked that if the good points of all of them could be embodied in one article, they would have an almost perfect apparatus. The following are among the appliances referred to.

Fig. 1 shows a boiler of American origin, which presents some special features. The heating-coils are formed of brass sections—hollow six-limbed crosses of cast brass—arranged in such a way that the heat from the burner impinges against each separate column from bottom to top, as shown in the diagram. The flue passes centrally through the boiler, so that a large amount of heat, which in many circulators is lost in the flue, is absorbed by the bulk of water in the cylinder itself. The hot-water flow-pipe, which is enclosed in the flue, also absorbs some of the waste heat. The heater is so planned that small quantities of hot water may be drawn off after a very short interval; the surplus passing back into the top of the cylinder. By disconnecting two unions, one at the top and one at the bottom, the heating-coils and expansion-pipe (the only portions of the apparatus where incrustation is likely to take place) can be readily removed for cleaning.

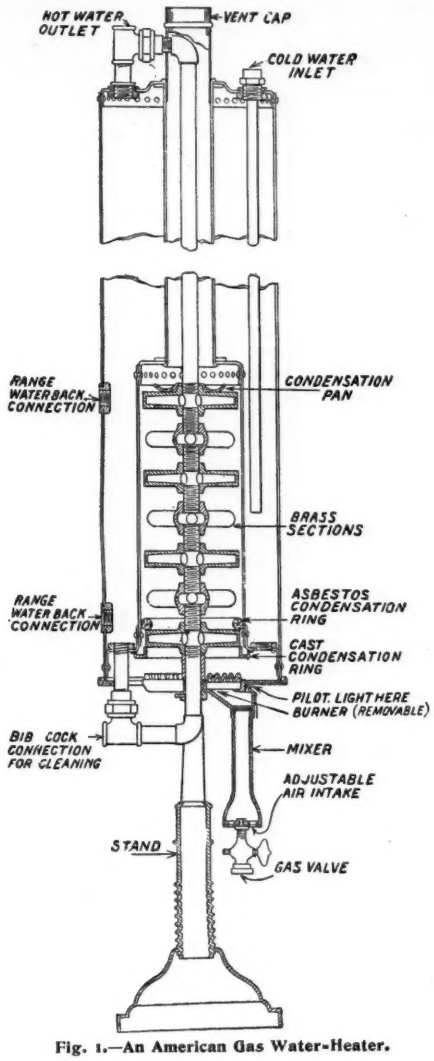


Fig. 1.—An American Gas Water-Heater.

Fig. 2 is made up of two cylinders, or inverted cups, each with one end closed. A smaller one B is placed inside a larger (A), and joined at the bottom; the space between being a water-jacket. The heating surface is increased by attaching to it a number of heat-conductors C formed of spiral wire, sunk into grooves, which abstract the heat from the gas products, and convey it by conduction to the surface of the water-jacket. The two cylinders may be separated by disconnecting at the flange joint; and when

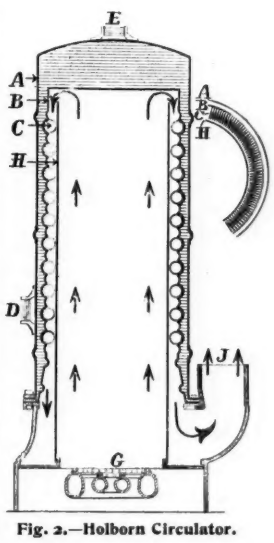


Fig. 2.—Holborn Circulator.

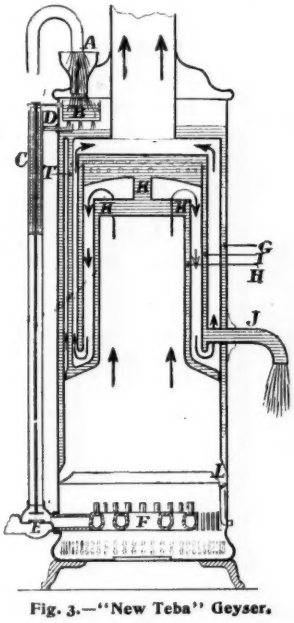


Fig. 3.—"New Teba" Geyser.

thus separated, all surfaces are fully accessible for cleaning or scraping. It will be noticed that there are no crevices or narrow spaces.

The geyser shown in fig. 3 is constructed on the "chamber heating" principle. The water enters at the funnel A from the open end of the tap. Passing into the upper reservoir, the water fills the outer jacket G, and overflows down the square tube T to the water-chamber. Thence it passes by cross tubes to the "boiling-chamber," flowing down the sides of this to the outlet J. The object of the safety gas-valve is to ensure that the gas shall not be alight unless water is actually passing through the geyser. A small bucket B receives the water at its entry; and, when full, this drops, and, by means of a simple lever and connecting-rod, lifts the gas-valve. The bucket has a few small holes in the bottom, which empty the water when the supply ceases. In this state, the gas-valve is heavier than the bucket, and consequently falls on its seating, shutting off the gas. Escape of gas is prevented by a modification of the well-known telescopic water-seal, as used in sliding gas-pendants—this being self-filled through a connection.

Mr. Carpenter next proceeded to give some of the points which seemed to be important in connection with

Circulators.

Plenty of Room in the Water-Chambers.—This is particularly important in districts where the water is hard.

Ability to Give a Supply of Hot Water Quickly from Cold.—Many consumers do not care to keep the burner going day and night, even if it is fitted with a thermostat, and are disappointed if they have to wait any length of time for the water to heat.

Durability.—Cost of maintenance will gradually lead to the greater use of iron (either partially or entirely) in construction.

Efficiency.—The reduction of heat loss in the flue to the irreducible minimum.

Appearance.—This usually has considerable weight with the lady of the house; and if the apparatus is clumsy or unattractive, it is greatly at a discount in her eyes.

Suitability of Size and Shape, so that room can be found for it in the limited space usually available in the kitchen.

Thermostats and Heat-Regulating Valves.

A large amount of ingenuity has been displayed in devising methods of automatically shutting-down the gas when the temperature of the water reaches a certain point; and a number of devices are on the market. Some forms shut the burner off entirely; others act on a burner made up of two concentric rings, shutting off the larger and leaving the smaller in use; others simply check the burner down. Where they are used in conjunction with bunsen burners, there is a risk of lighting-back. The plan of shutting the burner off entirely, and leaving a pilot-light only burning, seems the more economical where hot water is required only at fairly long intervals—the heat given out by a large gas-burner checked down, or a small ring burner, being more than is necessary to maintain the temperature of the already heated water.

Where the thermostat is used in connection with the tank system, it is somewhat late in coming into action, for this reason—the cold water supply pipe is connected to the hot-water storage tank, and no cold water reaches the circulator, or, in consequence, the thermostat, until the tank is emptied of its hot water, with the result that the burner does not light-up until cold water is being drawn from the hot-water taps. With the cylinder system, immediately hot water is drawn, the thermostat is brought into action by the incoming cold water, and a very sensitive action results.

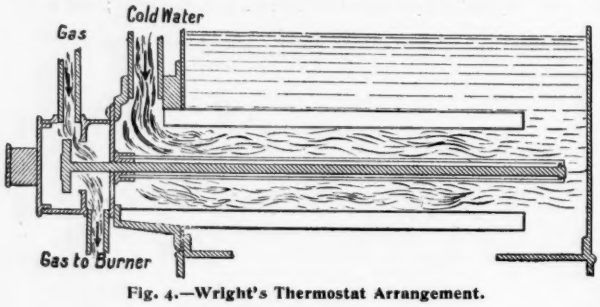


Fig. 4.—Wright's Thermostat Arrangement.

The action of the thermostat shown in fig. 4 depends upon the expansion and contraction of a metal rod. The position shown is that which obtains when the water is cold. The gas is able to pass freely from inlet to outlet, and the burners are full on. As the water heats up, the valve gradually approaches its seating, and finally shuts off the gas—leaving the pilot-light only going. When hot water is drawn, the cold water enters the chamber in which the rod is placed, the rod contracts, the valve re-opens, and the burner lights up. The action is very delicate, and the principle an excellent one. The consumption of gas by the pilot-light is small, and gives out sufficient heat to make up for the heat-loss in the boiler during idle hours. This ensures economical working. The "lift" of the valve can be regulated, so that the temperature at which the thermostat comes into action can be varied at will.

The action of the valve that is shown in fig. 5 depends upon the expansion of a special oil, which is contained in the expansion

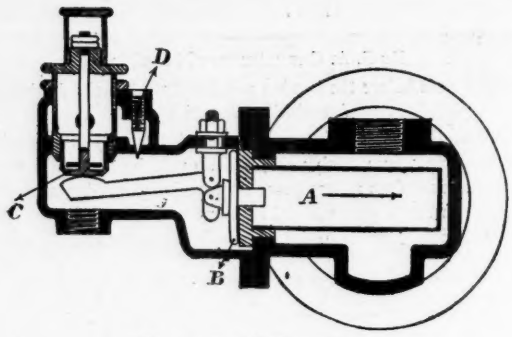


Fig. 5.—Davis's Thermostat.

chamber A. This chamber is so situated that the return water passes round it; and as the temperature rises, the oil expands, the capsule B is deflected, and, by means of suitable mechanism, this movement is communicated to the valve C, shutting off the gas to the burner. The bye-pass pin D can be adjusted to pass the quantity of gas required to maintain the desired temperature, when the main supply is cut off.

Efficiency.

The efficiency of geysers and circulators is of the first importance; and strenuous efforts are made by the makers to show high results. A certain apparatus is on the market which claims to boil 3 gallons of water with a consumption of 4·5 cubic feet, which, taking the initial temperature of the water as 60° Fahr., gives an efficiency of over 1000 B.Th.U. per cubic foot, which I think will be considered as a good performance. Lest the claim should be considered too modest, the makers go on to say that, in addition, the apparatus heats the apartment in which it is placed. It would be of interest to know the conditions under which the test was made.

Some difference of opinion exists as to the way in which an efficiency test should be carried out. I take the following method from the "Journal of Gas Lighting" for April 5, 1910. The water-heating apparatus is connected at the inlet—that is, the return-pipe flange—to a constant head of water, and a blank test is made to ascertain approximately, with a fair consumption of gas, the amount of water that can be passed through the heater and raised to a constant temperature of about 40° Fahr. above the inlet temperature. The gas is then turned off, the water kept flowing, and the heater cooled off. When the latter has resumed normal temperature, the difference in readings between the inlet and outlet thermometer is noted. The gas is then lighted—the gas consumption and flow of water remaining as before.

During the period of the test, the calorific value of the gas is frequently ascertained. When the water from the heater has reached a constant temperature, the difference between the inlet and outlet thermometers is carefully observed, and the flow of water per minute recorded, by noting the time taken to collect a measured volume and calculating from this result the flow of water per hour.

The following factors having been obtained—namely:

A—Difference between temperature of inlet and outlet water due to temperature of laboratory.
B—Difference between temperature of inlet and outlet water due to gas that is being consumed.
C—Gross calorific value of gas.
D—Amount of water flowing through heater, in pounds per hour.
E—Consumption of gas per hour.

$$\text{The percentage efficiency equals } \frac{D\,(B-A)\,100}{E\,C}$$

A series of tests carried out under the above conditions show an efficiency of 97 and 91·3 per cent. for open and closed type of geysers respectively, and 80 per cent. to 83 per cent. for circulators. It is pointed out by other authorities that, although the method just described is a good laboratory test, it does not pretend to take into consideration the many factors which exist in an actual installation—*e.g.*, the length of flow and return pipes, whether they are lagged or not, the situation of the hot-water storage tank, if protected or otherwise. Further, a lagged cylinder and an unlagged circulator might show similar results under the above test; but if the trial were to be extended over a period of weeks or months, the advantage would be on the side of the former, because of the smaller heat loss.

Warming Buildings by Hot Water.

The Englishman is strongly prejudiced in favour of the open fire, and for domestic purposes the hot-water radiator is hardly likely to displace it; but as an auxiliary method of heating, radiators have many advantages. When these are placed in halls, corridors, and landings, the air is warmed, so that on leaving a warm room one does not straightway pass into an icy atmosphere. If they are distributed through the house, a nice even temperature is obtained, cold draughts are not experienced when the doors are opened, and rooms which are only in occasional use are kept aired. Chills are frequently caught by passing from a warm room into cold passages and bedrooms, and a genial

temperature may be obtained right through the house where this system is in vogue. Radiators heat by radiation only to a small degree—about one-fifth of the heat given out being radiant heat, the balance being yielded up to the air coming in contact with the surface of the radiator as convected heat. A certain amount of prejudice exists against warmed air which (within certain limits) is quite unfounded. During the summer, we find temperatures of 60° to 65° Fahr. very agreeable; and if with our radiators we heat up to the same figure, there is no ground for any objection.

A boiler well known on the market is designed to work in conjunction with hot-water pipes or radiators for affording warmth to garages, rooms, glass-houses, &c. It is not intended for heating water for bath supply and domestic use, not but what it is an efficient heater, but when hard water is heated and drawn from taps and being constantly changed there is a deposit of lime from hard waters, and the boiler must be of a design and provided with lids to allow for cleaning. A heating boiler does not require this provision; for if the water is not changed with some frequency, there is no appreciable deposit of lime.

For large installations, a number of boilers may be coupled up to work as a battery. There is no limit to the number that may be used; and a battery of twenty gas-boilers certainly requires less attention than one coke-boiler. The great advantage of a battery is that the full number of boilers need only be lighted in severe weather; a less number being sufficient in milder weather. This ensures economy, regular temperature in the rooms, and a means of cleaning some of the boilers while the others are in use, and not stopping the warming while the cleaning is being done. Thermostats need not be fitted to these boilers, as it is not required to keep the water at a uniform temperature. The heat of the water should not be regular, but should vary with the weather, as a hot radiator is not needed on a mild day.

It will be agreed that the subject of hot water is a fascinating one. It offers a comparatively new field for the consumption of gas; and I think in time some form of gas-heated circulator will take the place of the coal-range boiler entirely, and be as universally used as the gas-cooker is now. Before this comes about, the gas apparatus will have to be much reduced in price, so that it can compete on more even terms with its rivals.

Discussion.

There were a large number of diagrams on view to illustrate the different forms of apparatus described by the author; and the Wright thermostat was shown in action. At the conclusion of the paper, many questions were asked by the members. Some of the points raised in the discussion are set out below.

Mr. Carpenter himself put the first question to the meeting—saying that he would be glad to hear the views of the members as to whether the efficiency of a geyser should be calculated on the gross or the net calorific power of the gas. He said he had his own view; but he wished to hear what that of other persons was. Another point was that people often said that radiators and gas-fires generally dried the air; but a coal-fire warmed the air to the same extent as a gas-fire. Of course, the only effect of warming the air was to increase its capacity for moisture. Why, therefore, did people talk of gas-fires drying the air, while with coal-fires the trouble never seemed to occur to them?

The President (Mr. J. G. Clark, of the Gaslight and Coke Company), in opening the discussion, remarked that the paper was an interesting one, and contained a lot of information. All who watched the trend of gas affairs nowadays must recognize what a great future there was for gaseous fuel, for both domestic and industrial uses. Hot water was indispensable; and there was thus an enormous field for apparatus which would provide it.

Mr. F. Ainsworth (Ilford) said it was most important for them to do all they could to make these appliances known. There was competition; and the electrical people were not always scrupulously careful in the claims they made. What was the opinion of the author with regard to the fixing of open geysers in places where the ventilation was not quite so good as might be wished? Was the open or the closed type the better, so far as back-draught getting into the room was concerned? Then as to the burners. He did not himself believe in "whistling;" but people had said to him that the burners should "whistle." His own view was that they should have sufficient gas; and if they had a good governor, and worked at one rate, he thought this was best for both geysers and hot-water radiators. Geysers were now produced much more cheaply than formerly; and they gave excellent results. They wanted to be able to buy them cheaply, fix them cheaply, and be confident that they would be economical in use.

Mr. S. B. Chandler (South Metropolitan Gas Company), referring to what were termed "radiators," said he was always under the impression that these appliances gave no radiant heat.

Mr. Carpenter: I understand they give one-fifth of their total heat as radiant heat.

Mr. Chandler: I always thought that radiant heat could only come from an incandescent source.

Mr. W. T. Burton (Leatherhead), alluding to complaints as to gas-fires, asked the members whether they did not think that, in nine cases out of ten, these were due to defective fitting. He would be glad to know the address of the firm who claimed an efficiency of over 1000 B.Th.U. per cubic foot.

Mr. J. R. Gale (Mill Hill) said it seemed strange to him that bunsen burners, rather than luminous flames, should not be used in geysers. As to Mr. Ainsworth's point about cost, had he heard of an arrangement for heating bath water, by means of placing the appliance in the water itself? It was very cheap; but the room should be ventilated.

Mr. W. E. Brown (Gaslight and Coke Company) remarked that, in connection with the question as to drying of the air, one point had struck him. Supposing a person was sitting in a room, and the temperature got up to 70°, if it was heated by a coal-fire one would not put any more coal on; but if there was a gas-fire one would not trouble to turn the gas off. He thought, therefore, that complaints as to the drying of air arose partly from overheating. To his mind the extent to which circulators and hot-water apparatus generally would come into use would depend more than anything else upon how far gas undertakings would go in placing them on their hire lists. For every appliance that was sold, a dozen would be hired out. Thus maintenance became an important question. In the case of an ordinary copper circulator, what would be done when it was necessary to examine it for lime deposits? He presumed it would be removed and inspected at the works.

Mr. D. C. Cross (Lea Bridge) said he had had a somewhat strange experience with a circulator in his house. The principle of the circulator, as he understood it, depended upon the change of temperature, which caused the circulation—the greater the change of temperature, the greater the circulation. In the apparatus to which he was now referring, the temperature was often allowed to get rather high, and so there was a high motive power in the pipes. The result was that there was trouble with the boiler connections, and leaks kept on occurring. A new boiler was put in; but the same trouble arose again. Then an entirely new range was fitted; but the architect said if the circulator was fixed to it, he would not be responsible. With regard to the use of an iron flue pipe, they had found the condensation products had a very detrimental effect; and it was altered to copper. This improved matters. He thought copper was far superior to iron for the purpose. Turning to geysers, he had in mind a small one for office use which had no automatic tap for turning on the water before the gas was lighted. It was a bad thing to fix appliances with which it was possible to turn on the gas before the water; and geysers ought to have an automatic arrangement which would prevent this being done.

Mr. Briggs, referring to the statement of the author that, with tank systems, the thermostat was somewhat late coming into action, because the cold-water supply-pipe was connected to the hot-water storage tank, and consequently no cold water reached the thermostat until the tank was emptied of its hot water, asked whether it would not be better for the cold-water feed to enter the return-pipe. It would then act quickly on the thermostat.

The President remarked, in regard to the variety of types of water-heaters, that a thing which would do in one place would not be suitable for another—not because the principles were unsound, but because conditions varied. This was why they had such a wide range of appliances available. Some reference had been made to the "gilled" circulator. It had been thought that this would become furred quickly; but he remembered some time ago looking at a drawing of, he believed, a Yarrow or Thornycroft water-tube boiler, and noticing that the tubes employed in it had a peculiar curve. This curve had been so arranged as to come right in the combustion zone of the furnace, so that local heating would take place, which would cause the water circulating through to spurt. This local heating would cause the water at this point to be much hotter than at other points, and there would be small pockets of steam there. There would thus be a continuous spurting action, which would counteract to a large extent any tendency to form fur in the tubes. This was just the sort of thing that took place in a circulator like the "gilled." There was water enclosed between a number of narrow spaces; but, owing to local heating, it would be found that the water was moving very rapidly in these spaces. This went far—in fact, the action was almost complete—in disintegrating any fur that would tend to form. The same thing occurred to him in looking at a kettle which was provided with small tubes at the bottom. He thought at first that these would soon become furred. But, as a matter of fact, local heating would take place in the tubes, while the water in the kettle proper remained comparatively cool; and the spurting action set up would prevent the excessive lime deposit one might expect to find in such an appliance. In connection with the demonstration they had just had with the thermostat, the promptness of the action of the instrument was noticeable—that was to say, the gas was reduced from full to low consumption in a very short time. Some three years ago he had occasion to investigate very closely the behaviour of a number of thermostats; and, as a result, he was enabled to form an opinion in his own mind as to how a thermostat should act. Two or three that he had examined behaved in an inefficient manner, because of their sluggish action. They reduced the gas all right, but took a long time to do it; and the function of an efficient thermostat should be to act very promptly. He was pleased to say that since this time improvements had taken place; and the importance of the prompt thermostat was now fully realized. A sluggish thermostat would impair the thermal efficiency and practical utility of a water-heater. With regard to the use of the thermostat with bunsen burners and with flat flames, it was possible to reduce a flat-flame burner to a lower point than a bunsen; but they did not want to reduce the gas to such a degree that it would not be of any use. He felt quite sure that, from a practical point of view, the thermostat was quite satisfactory with a properly arranged bunsen burner. There were many installations

working on this principle, which was sufficient proof that it could be done. As to gross and net values for percentage efficiency. Mr. Carpenter had asked for some opinions; and, as none had been offered, he would give his. He thought the method to be adopted was fairly obvious; there was not the slightest doubt as to what ought to be done. The net value was the yield obtained from the gas when the water products were allowed to escape uncondensed. When the water was condensed, they got an additional quantity of heat equal to (approximately) 10 per cent. of the total heat given off in the combustion of the gas. Those of them who knew anything about hot-water appliances would be well aware that they got condensation more or less. Sometimes it was small, and at other times great; but they did get it, and they ought to get it. They ought to utilize the heat of the gas to the fullest possible extent, and the apparatus used should be designed accordingly. The fact that they obtained even the smallest amount of condensation was, to his mind, quite sufficient to justify them in basing their percentage efficiency upon the gross value; and as this condition existed in practically every case, the gross value should be the figure used for the efficiency of hot-water appliances. In cases where, for a particular reason, special efforts were made to avoid condensation, then the net value was the right basis to adopt. With regard to the respective merits of cast iron and copper, a question often raised was as to the conductivity of metals; but the importance of this could be easily over-estimated. Of course, if they took copper of a certain gauge, and compared it with a cast-iron boiler where the metal might be several times as thick, the conductivity of the copper would be greater than that of the iron. That was to say, the thicker they made the partition between the fire and the water, the greater was the resistance to heat transmission. But when they came to think of it, the heat resistance of the metal in any case was very low, and it did not matter much if it was increased two or three or even a greater number of times. The conductivity of all metals was very high; and, as a matter of fact, a very small fraction of an inch of soot on the fire side or a similar quantity of scale on the water side would do more to resist the passage of heat through the metal than the thickness of the metal itself. Generally speaking, there was much to say in favour of cast iron. The "Potterton" boiler was made throughout of cast iron; and the efficiency obtained was very good. What did Mr. Carpenter consider a desirable temperature for hot water? The efficiency claim of 1000 B.Th.U. per cubic foot referred to in the paper was "something to go on with." He thought some time ago they saw in the papers a statement respecting the thermal efficiency of a water-heater, and learnt afterwards that the test had been based on American natural gas, which had a very high value, on account of the large percentage of methane it contained. Moreover, it must not be forgotten that the American gallon was only eight-tenths of the English gallon. Some of the appliances in this country came from America, and had their efficiency based on the American gallon. Mr. Carpenter had given them a simple formula for calculating these efficiencies in thermal units, and he (the President) suggested that all the members should become conversant with the calculation. They would often find it an interesting and amusing pastime to calculate efficiencies from reports of performances of water-heaters—gas, coke, and electric.

Mr. W. L. Westbrook suggested that a thermostat coming into action suddenly on a bunsen burner might cause firing-back.

The President: If it acts really suddenly, it might. But I do not mean so suddenly as the valve of a geyser would act. I mean within the space of (say) thirty seconds, which would be instantaneous for all practical purposes.

Mr. Carpenter, in replying to the discussion, said that, of course, with the open geyser there was always more risk of back-draught, because the flue gases were pressed back, as it were, by the incoming water. There was always a much better up-draught with the closed form. He would not imagine that anyone was going to get good efficiency with the burner "whistling." There seemed some tendency to get too much gas going with geysers; and unless there was a good air supply, there would not be complete combustion of the gas. As to radiant heat from radiators, to speak frankly he had his doubts as to whether they really got any; but he saw the claim referred to in his paper made by someone who might be regarded as an authority, and so he made use of the figure. Mr. Burton had "hit the nail on the head" with his remark about complaints of gas-fires being due to faulty fitting. The same gentleman had expressed interest in the apparatus said to be capable of developing 1000 B.Th.U. per cubic foot of gas. Well, they might assume that it was an American appliance using natural gas; but the statement was issued by a firm having its offices in London, and there was nothing to lead one to suppose that other than London gas was used. He was glad that Mr. Gale had mentioned that little bath-heater. It was a very cheap and efficient thing. Bunsen burners, he believed, were used in some geysers; but, of course, one could not always depend upon getting a good up-draught with a geyser, and if the bunsen flame came into contact with the cold metal one was rather apt to get an unpleasant smell. It would, he should think, be quite impossible to let out copper circulators on hire, on account of the life. They must have the iron circulator.

Mr. Brown: We have thousands.

Mr. Carpenter (continuing) said he agreed with Mr. Cross as to the necessity for providing geysers with locking gear or some form of dual valve which would prevent the gas being turned on before the water. With reference to the suggestion for carrying the cold water supply into the return pipe, to get a quick action on the thermostat, it should assist in securing this object; but he did not know whether the circulator would be adversely affected. Then, again, when the circulator came to be connected up with an existing hot-water installation, where the cold water supply had already been taken into the storage tank, this would have to be altered in order to carry out the idea. He quite agreed with the President as to making calculations of the efficiency of geysers on the gross calorific value of the gas. The temperature that was required for water depended entirely, of course, on the purpose for which it was to be used. For a bath, they needed from 95° to 100°; while for sink use, a higher temperature was desirable.

The President, alluding to Mr. Chandler's question as to whether there was any radiant heat from radiators, said there undoubtedly was some. The question was how much. Incandescence was not necessary for radiation. Let them try to stand near a block of cast iron that was just below red heat, and they would find there was some radiant heat. This proved that radiation did come from black surfaces. It was not much; but when they took into account the large surfaces from which it was coming, this made up for the small amount. He should imagine that something like 10 to 20 per cent. might be taken as the heat obtained by radiation from a radiator. It was a figure that had not been exactly determined.

Mr. Chandler: As most of the heat is convected heat, why not call them "convectors"?

The President: That term is being used—showing that the idea of the convector, as apart from the radiator, is now fairly well understood.

Before the meeting dispersed, Mr. Carpenter was accorded a hearty vote of thanks for his paper, on the proposition of Mr. Ainsworth, seconded by Mr. J. Hewett.

YORKSHIRE JUNIOR GAS ASSOCIATION.

In the absence of the President, owing to family bereavement, one of the Vice-Presidents, Mr. C. T. B. Roper, occupied the chair at the usual monthly meeting, which was held at the Leeds Institute. Two papers were submitted, both being the maiden efforts of hitherto silent members.

CONSTRUCTING A GADD AND MASON HOLDER IN A COLUMN-GUIDED HOLDER TANK.

By W. Dawes, of Castleford.

The experiences of last winter at Normanton made it imperative to increase the storage capacity in order to satisfactorily meet the demand for the coming winter. The then storage consisted of two gasholders—one two-lift Gadd and Mason, 80 feet in diameter, and a single-lift column-guided holder, 80 feet diameter—having a combined capacity of about 260,000 cubic feet, 85,000 cubic feet of which was only available for day consumption, whereas the daily output exceeded 270,000 cubic feet, and chiefly consisted of a lighting load.

Two schemes presented themselves for consideration. One was to erect an entirely new gasholder and tank, with all necessary connections, valves, &c., to be coupled to existing connections, on land already in possession of the Company. The other scheme was to sacrifice the single-lift holder in order to utilize its tank for a new three-lift holder. The latter scheme proved to be by far the cheaper.

In entering into the contract, it was understood that the minimum pressure of the inner lift was to be 4 inches; and in order to obtain this, a ring of cast-iron weights was to be placed inside the holder on a level with the cup channel of the inner lift. Provision was made to use the crown framing of the holder in question, if found to be in good condition. After stripping the holder of its sheeting, the crown framing was found to be constructed of material the weight of which was much in excess of that used at the present day. This fact did away with the necessity of using a ring of cast-iron weights as mentioned above.

Tank.

On pumping the water from the tank, it was found to be constructed as follows.

Brick and puddled, 83 feet diameter by 20 feet deep, with a very shallow puddled dumpling. The inlet and outlet pipes are 12 inches and 15 inches respectively, and are surrounded from the dumpling to 7 feet from the top of each pipe with brick columns. These pipes are separated, and are, from centre to centre, 29 ft. 3 in. The resting pier for the holder centre pipe is made of brick, and is 4 ft. 7 in. square. There are nineteen rest-blocks made of stone, 4 ft. 6 in. long by 2 ft. wide by 1 ft. 3 in. deep.

Examination of the tank wall disclosed two fractures on opposite sides of tank, which had been caused by subsidence twenty-five years ago. At that time, this was the only holder possessed by the Company; and steps were taken to stop the leakage of water in the following manner: Two pockets 4 ft. by 6 in., and reaching from top to bottom of tank, were made, placed in position, and securely fastened by clips passing through the tank walls at the top and under the coping stone. Sawdust, dung, &c., were freely put into these pockets and allowed to settle in the fracture. At the same time, the tank was kept filled with water from a neighbouring colliery until the leakage was quite stopped. It remained in this

condition till the tank was emptied, when a fracture, 1 inch to 2 inches in zig-zag formation, covering about 18 inches between parallels, was disclosed. The tank wall was refaced where fractured, and concrete grouting was run in after every second course had been laid. The remainder of the tank was in good condition, excepting a few courses below the coping stones which had been weathered. These were cement pointed.

On the side of the tank which had fallen, the rest-blocks were found to be from $\frac{3}{8}$ inch to $3\frac{3}{4}$ inches out of level. These were all levelled-up by concrete slabs, cemented over, after the rest-blocks had been extended to suit the three-lift holder then about to be erected.

The channel-iron guides fastened to the side of the tank, which had acted as guides for the old holder bottom carriages, were pulled down, the bolts knocked out, and the holes thus formed filled in and faced with cement.

On taking the guide-framing down, the cross girders were first removed. The columns, which were cylindrical and made of cast iron, were broken off at the base, while they were securely held at the crown by block pulleys, fastened to a pair of steel legs, 30 feet high, braced together, and held in position by steel ropes fastened to stakes driven in the ground. When the base was broken, the column was gently let down on to a bogie, wheeled away, and broken up. The base-plates were then unfastened, and the 2-inch bolts were utilized for the bed-plates of the new guide-carriage base-plates. The water was pumped out of the tank by means of a 2-inch donkey pump, and run into the works reservoir. Town water, which was metered and thus paid for, was used to fill the tank; and this was taken from a hydrant near by.

Crown Framing.

The crown framing consists of eighteen main bars of $4\frac{1}{2}$ in. by $4\frac{1}{2}$ in. by $\frac{1}{2}$ in. T wrought-iron and a cast iron centre-pipe. The bars are all secured to the centre-pipe by main tension rods, $1\frac{1}{4}$ inches in diameter. The main bar tension rods are $1\frac{1}{4}$ inches diameter, and the cast-iron struts are of 5-inch and $4\frac{1}{2}$-inch cross section. The centre-pipe is 11 ft. 6 in. high, and the rise of the crown is 4 ft. 8 in. The crown plate is 4 feet diameter and $\frac{5}{8}$ inch thick. There are three main bracket bars between each two main bars, and also four cross bracket bars and five ordinary bars.

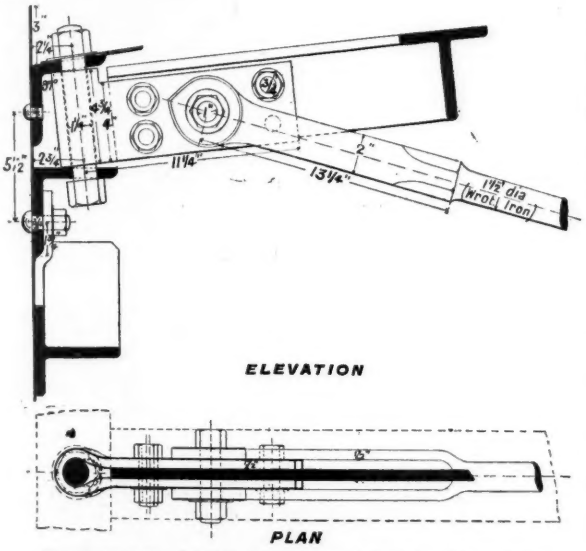


Fig. 1.—Details of Connections of the Main Bar and Top Curb.

The top curb (shown in fig. 1) consists of two angles. The upper one is of steel, 4 in. by 4 in. by $\frac{1}{2}$ in. section, and is opened at an angle of 97 degrees. The lower angle iron is of $4\frac{1}{2}$ in. by $4\frac{1}{2}$ in. by $\frac{1}{2}$ in. wrought-iron section. An eye-piece is fastened by three bolts to the end of each main bar, and a $1\frac{1}{4}$-inch bolt passes through the eye and fastens the main bar between the two angle irons.

The main tension rod is fastened to the eye-piece as shown. The modern method of fastening the main tension rod to the main bar is by means of gusset plates bolted on to the main bar and vertical stay; but considering that the above method had proved satisfactory for forty-two years, it was thought advisable to adopt the same method in the new holder.

The whole of the crown framing, with the exception of the upper angle iron of the top curb and the centre-pipe, is wrought iron. The lower angle iron of the top curb, as well as the whole of the crown framing, was also re-used in the new holder.

To suit the new requirements, the crown framing had to be reduced to 75 feet in diameter.

Inner Lift.

The inner lift is 75 feet diameter and 20 feet deep. The top curb being 20 feet from the rest blocks, it was seen that the rise of the crown would be slightly diminished by cutting off the necessary lengths from the main, secondary, and tertiary bars, to give the required diameter. It was found that the centre-pipe base could be lowered a little. So this was done; and the main tension rods were taken out and shortened, in order to allow the extremity of the main bars to fall to the proper radius.

The old vertical stays were re-used, and consist of T-iron 4 inches wide. The cup, 24 in. deep by 9 in. wide, is formed of 9 in. by 3 in. channel steel. The skirting plate is 24 in. deep by $\frac{1}{4}$ in. thick; and this is stiffened round the upper edge with $2\frac{1}{2}$ in. by $\frac{3}{8}$ in. flat iron, riveted on with $\frac{5}{8}$-inch rivets, 6-inch centres. The ends of the channel steel butt solidly together, and are united by means of a 24 in. by 9 in. by $\frac{1}{2}$ in. cover plate. The centre crown plate is 5 feet diameter and $\frac{3}{16}$-inch thick; and the first and bottom rows of crown sheets are No. 9 S.W.G. and the five intermediate rows No. 12 S.W.G. All the crown sheets are arranged radially; and all the sheets in a ring are the same size.

Two rows of $\frac{3}{4}$-inch gas-tubing, supported by 2 in. by $\frac{3}{8}$ in. flat iron stands of ornamental design, are fixed to the crown sheeting. The top and bottom rows of side sheets are No. 10 S.W.G., the six intermediate rows are No. 12 S.W.G., and the vertical stays are bolted to the cup channel steel and the spiral plates where they cross.

The top side sheets rise 3 inches above the top curb, and form a spout for the collection of accumulated rain water, &c., which flows down the rail through openings left for the purpose opposite the rail, and so does not discolour the paint on the holder.

An oval manhole is fixed in the side sheeting of each lift, just above the cup. There are three manholes in the crown sheeting; and these are so arranged that when the holder is down on the rest-blocks, there is a manhole over both the inlet and outlet pipes, to facilitate matters if a blockage should occur.

Middle Lift.

The middle lift is 77 ft. 6 in. diameter and 20 feet deep. The top and bottom rows of side sheets are No. 11 S.W.G., six intermediate rows of No. 13 S.W.G. The vertical stays are of 8 in. by 3 in. channel steel. The cup and dip are of the same dimensions as for the inner lift, only the skirting plate is $\frac{3}{16}$ inch thick, instead of $\frac{1}{4}$ inch. The top side sheets rise 2 inches above the channel steel, to take away rain, &c.

Outer Lift.

The outer lift is 80 feet in diameter and 20 feet deep; and the sheeting, vertical stays, cup, and dip are of the same thickness and dimensions as for the middle lift. The top side sheets also rise 2 inches above the channel steel.

The ironwork was riveted together in segments in the workshops and sent to the site to be completed. The parts that were riveted together on the site itself were the joints of the segments of the angle curbs, dips, and cups, the spiral plates to the sheeting, and the crown and side sheeting, with the exception of the row of sheets adjacent to the cups and dips.

Rivets, $\frac{1}{4}$-inch, worked cold, were used throughout on all the sheeting, with the exception of $\frac{3}{8}$-inch rivets which were used to fasten the spiral plates to the side sheets, and they were also used on the crown plate. All rivets above $\frac{1}{4}$ inch were worked while red hot. The $\frac{1}{4}$ inch rivets had a pitch of 1 inch, and the sheets had a lap of 1 inch. The top curb rivets are $\frac{3}{4}$ inch diameter, $2\frac{1}{4}$ inch pitch. The skirting plate and sheets to the cup and dip channels have rivets $\frac{5}{8}$ inch diameter, 2 inch pitch. The rivets used to fasten the sheets to the bottom curb on the outer lift are $\frac{3}{4}$ inch diameter, 6 inch pitch.

The vertical joints of the sheets were not placed under each other, but zig-zag. Tape soaked in red lead was used for the joints of all sheeting, and cloth soaked in the same solution was used for the joint between the cover plate which fastens the segments together.

For the benefit of those who have not seen a middle or outer lift lowered into position during construction, I will try and explain how this operation is worked.

In the first place, planks are stretched from the inner lift framing to the stone coping at intervals, and made level all the way round. The cup is then placed in position on these planks. The spiral plates, rails, and vertical stays are placed in position. Two or three rows of sheets are then fixed and riveted together. The lift is then let down as follows: Two planks C, which are fastened together and having a space between them, are attached at one end to the main bar by the clip D, as in fig. 2. This double plank is made level by placing a block K under the other end and resting on the top curb of the inner lift. A hook A is made to fix on the cup (as shown), and this is held in position by the long bolt B and the hook E.

These bolts are marked with chalk at intervals of 3 inches, and a man is told off to each of the eighteen bolts. When the lift is ready for lowering, the planks which have held it in position at first are removed, and the nut F is turned so that the lift is lowered to the position in which it is required. When the signal is given, the nuts are turned together, and each man, of course, bears a certain amount of weight on his nut, which if he turns too fast he will find feel loose, where, on the other hand, if he does not turn fast enough the nut becomes very hard to turn. Knowing hands sometimes deliberately throw strain on "green" ones, and these men have to be watched. The next rows of sheets are then riveted together, and the operation commences again. The only difference is that the bolt is not long enough to let down the lift to the rest-blocks; so the difficulty is overcome by connecting the hook A to the hook E by chains.

When the second row of sheets from the top has been reached,

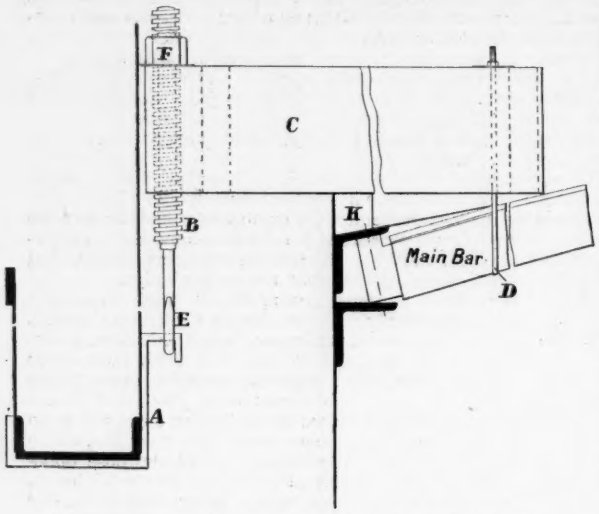


Fig. 2.—Lowering the Middle and Outer Lifts into Position.

the dip is placed in position. It is held by block pulleys until the sheets adjacent to it have been riveted to the next row. When this is finished, the lift is lowered on to the rest-blocks, and a man goes down into the tank bottom and disconnects the hook from the cups.

The rails for the rollers are fastened to the side sheets by means of Dempster's patent continuous spiral-guide plate. The special feature of this plate is that it allows the spiral rail to be riveted direct to it; the rail being bedded on a flat surface its whole length. Prior to its introduction, the rivets where the rails crossed the seams had to be knocked down flat, and the rails riveted as closely as possible to the sheeting with stiffening flats on the inside of the sheeting. This was found unsatisfactory, as moisture collected at the back of the rail and caused oxidization in the sheets behind, where it was impossible to scrape or paint.

Unless in very deep holders, the rail and rail plate are rolled in one length. The plate is usually ¼ inch thick and 12 inches wide, and being secured to the curb and dip or cup channel, as the case may be, and the vertical stays intermediately, adds tremendously to the strength of the holder sides. The rail weighs 41 lbs. per lineal yard.

Allowance is made for expansion on the carriages to the extent of ⅜ inch per carriage. The rollers are of "Keyte's" patent adjustable type, and are made of cast iron, being turned and bored and working loose on a turned steel axle. In fixing the carriages, the base-plates were drilled *in situ*; and the erection having taken place during the hot summer, the rollers were fixed well back from the side of the holder, so that there is room for contraction during the winter. If these rollers had been fixed in winter, they would have been placed well in towards the holder to allow for expansion in the summer.

The holder is fitted with an anti-freezing arrangement, which consists of a separate injector attached to the dips of the middle and outer lifts and also to the stone coping of the tank. The injectors are connected to each other by flexible hose, and are supplied with steam from one special service.

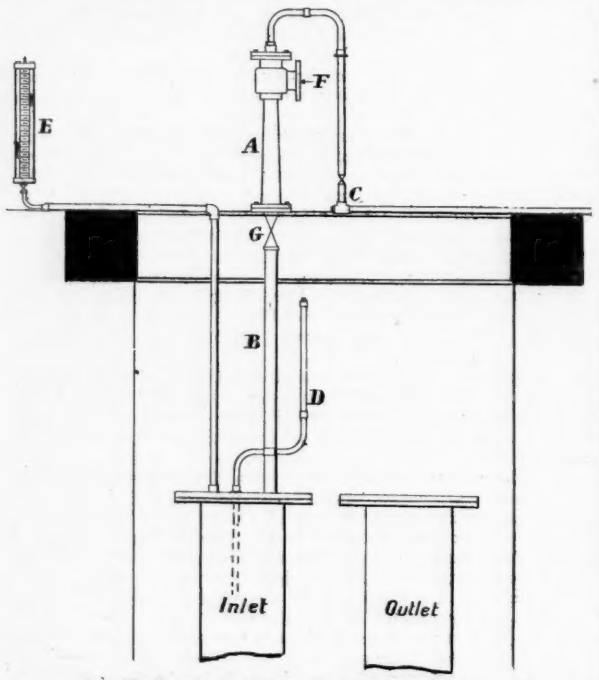


Fig. 3.—Appliances for Testing the Holder.

The holder is also fitted with a Davey patent ladder, having collapsible rungs. These rungs close up when they come in contact with the dip, as the holder descends. When the ladder is required for use, each rung has to be opened out as the person goes up step by step.

Testing of the Holder.

The method adopted for filling the holder with air was by means of an injector fastened on to the inlet-pipe.

Referring to fig. 3: Steam is led to the injector A by the pipe C, and air is drawn in at F and forced into the holder through the pipe B. The pipe D goes to the bottom of the inlet-pipe, and through this condensed water, &c., is pumped out. The pressure-gauge E registers the pressure thrown by the holder.

The whole of the work had been done in ideal weather, and the test proved satisfactory in every way. Except for a little "weeping" round the top curb, it was otherwise thoroughly tight, and was immediately put into action. All joints of the sheeting were tested with soap solution.

When the holder had been filled with air and left for a little time, it was found to have gone down a few rivets. This was due to the steam, which had intermingled with the air during injection, condensing.

The valve shown at G was opened and the air allowed to rush out of the holder. Gas was then allowed to go into the holder to the extent of about 200,000 cubic feet; and this was worked back into the two-lift holder.

Painting.

During erection, special precautions were taken as regards painting. All the sheets were delivered after having received a coat of oil. Various paints were tested, when it was found that some special gasholder paints do not adhere readily to a surface covered with oil. A good coating of white lead paint mixed with oil, dryers, turps, and terebine was put on the ironwork immediately on erection, and after completion a further coating of paint with a graphite base.

The holder, when completed, was of a good shape, free from buckles, tight in every respect, and altogether a very satisfactory job. The capacity of the new holder is 264,000 cubic feet. The Contractors for the work were Messrs. Robert Dempster and Sons, of Elland.

The paper was illustrated by a series of large drawings, various blue prints, &c.; and Mr. Dawes had had slips printed containing the illustrations given in his communication. These were distributed to the members, who were thus the better able to follow the descriptions read and the incidental additions.

Discussion.

Mr. E. Garsed asked, in connection with the lowering of the outer lifts, how the cup was supported when the bolts had been run out to their full length, and chains were to be inserted. Also whether there was any special reason for using a steam-jet injector when filling the holder with air. He should have thought an exhauster could have been utilized, or a special blower brought down for the purpose. The paper described how the top side-sheets were carried up 3 inches beyond the top curb, so that the rain-water falling on the crown should be only allowed to flow down the rails, and thus a general discoloration of the painted sides be avoided. Did they ever find this water remaining in hollows, &c., round the crown, and setting up local corrosion?

Mr. F. Scholefield asked how the air remaining in the crown and under the cups was dealt with when proceeding to fill the holder with gas. No mention had been made in the paper of any of the usual precautions adopted for clearing out this air, and doing so safely.

Mr. C. Roper asked the meaning of the statement that, out of the previous storage capacity of 260,000 cubic feet, 85,000 cubic feet was only available for day consumption.

Mr. Cranfield asked what colour the holder was painted. Did the phrase "a graphite base" mean that the holder was black? He had hoped that Normanton was sufficiently removed from the worst atmospheric conditions of the manufacturing part of the West Riding to allow of the light colour being used which was now adopted for holders in some parts of this and Continental countries. Though a holder could not be made an object of beauty, and adornment was out of place on it, it should, whenever practicable, be made as inconspicuous as possible. In flat districts, it was surprising how much less interference with light and with the general agreeableness of the surroundings there was when a holder was painted white, grey, or slate. He had some doubts as to the advisability of the arrangement for collecting the rain from the crown and guiding it down the rails—at least in some localities, where notable amounts of gritty dust from factory chimneys and railway engines on high viaducts fell on the holders. He knew of cases where this was a very real trouble, and could conceive of this stuff getting accumulated along the top curb and leading to increased liability of corrosion.

Mr. Dawes, in reply, stated that, in lowering the outer lifts, as soon as the lowering bolts were run out nearly to the end, one would be disengaged, a chain attached, and then the bolt run up again until the chain was taut. This operation would be repeated singly at each of the eighteen bolts, so no other means of temporarily supporting the cup would be needed. The use of a steam-

injector for filling the holder with air arose chiefly from the fact that the exhausters were some two or three hundred yards away, while a boiler was handy. The 85,000 cubic feet of storage that was only available for day supply was accounted for by the fact that, when the holders had got so low that only this amount remained in them, they did not throw enough pressure for a night supply. The new holder was painted a dark chocolate colour; and as he left the Normanton works soon after the holder was put into use, and before any great amount of rain had fallen, he could not just then say anything about the efficacy of the water-shedding arrangements. The holder lifts threw respectively 47-10ths, 28-10ths, and 20-10ths pressure.

PUBLIC LIGHTING.

By E. Garsed, of Elland.

To stand on a high point, among some of our West Riding hills, on a clear night, and look over miles of extent of country, intersected with lines of brilliant incandescent gas lights, is an experience which, in itself (apart from relative costs or any such like arguments), is convincing of the unquestionable superiority of incandescent gas, and of the grounds for the turn in public opinion in its favour as compared with electricity. Why is it that more up-to-date, extensive, and complete schemes of public lighting are not taken in hand? Would it not tend to lessen some of the social evils or dangers existent in many parts of the country? And is not this alone sufficient justification for a big move in this direction? I venture to suggest that a higher tone of social and of moral conditions, a better feeling of personal safety, and perhaps even of national welfare, would be established from such a course, and to such a degree as to warrant the compulsory lighting of every road, street, and public footpath within reasonable limits of all thickly-populated areas.

Public Lighting by Obsolete Flat-Flame Burners.

A glance through the yearly returns of the gas undertakings in the United Kingdom will reveal rather an astonishing fact in the matter of public lamps—viz., the number of flat-flame burners still in use; and it would seem that, speaking generally, the extent to which these latter do survive is greatly under-estimated. It is a matter of wonder at once why the number is so large. The answer may be found in a number of causes; but perhaps the chief reason is that in so many cases the public lighting is controlled by a public department separate and distinct from the gas undertaking of the district, especially so where gas is supplied by a private company. In the latter case, it may even be the fault of the gas authority; but far more likely from the inability of the latter to act, through the difficulty or impossibility of approaching the local authority. It may be that the cost of replacing old lanterns with those of the type claimed to be storm-proof is considered prohibitive, though often enough lamps have been converted to incandescent without even a thought of consequences in this direction—many old lanterns being used. The question of the increased cost of maintenance through breakage of mantles, also, has doubtless something to do with this large number of the now obsolete flat-flame burners.

The Control of Public Lighting.

At all events, it would appear that, whatever the cause, the public lighting department does not receive, or has not (with all due respect to those districts where efficient control of this department does exist) received due attention from the right quarter, especially in small towns and villages. And it is not unreasonable for us to expect that the "right quarter" should be the gas authority, working under amicable and equitable arrangements with the local authority, whether the former be part of, or separate from, the latter. This view is, however, far from being shared by local authorities where gas is supplied by a company, though one has only to point to some of our large cities to show the distinct advantages and public comforts enjoyed by some such system of efficient control.

One of the greatest disadvantages of the administration being carried out by the local authority is the system of average consumption usually prevailing for ascertaining the total consumption per period. Such a system as where lamps are only metered one in (say) ten cannot be wholly satisfactory, as there is no real straight edge, so to speak, of working. In the first place, the responsibility for complaints or faults cannot easily be settled upon either party, which may create a position so undesirable as to be a source of controversy or friction. Also the indirect or round-about reporting of, and remedying of, faults causes unnecessary delay and loss of efficiency; such delay, when in reference to meter lamps, being, of course, a serious matter to the gas authority, who stand to lose ten-fold in these faults as compared with unmetered lamps. Again, the fact of two parties being involved causes much unavoidable expense to each; and this, in the case of the gas authority, for whom it is necessary to keep a more or less strict watch against all possible irregularities (which may or may not increase unaccounted-for gas) is a matter of no small consideration.

If, then, by proper and equitable agreement, the gas authority were to become solely responsible for the administration of public lighting, many at present undesirable factors and conditions would be swept away, better satisfaction would be given all round, more efficient lighting would, in general, be the rule; while, by no means least, the system would, judging from the figures given below, be a less expensive item in the general district rates.

The following particulars have reference to three districts, joining up to each other, the lighting of which is controlled by the respective district councils.

No.	Total Lamps.	Cost per Lamp. s. d.	Incandescent. Per Cent.	Incandescent. Average Per Cent.	Cost Average. s. d.
1	343 (Gas) 59 (Incandescent electric)	.. 36 7½	.. 50	.. — ..	—
2	141 ..	.. 30 2½	.. 88	.. 60 ..	34 9
3	236 ..	.. 34 4	.. 41	.. — ..	—

The average consumption of gas coming into the rentals of the gas authority from the above per lamp were: No. 1 district, 7450 cubic feet; No. 2, 6730 cubic feet; No. 3, 7730 cubic feet. The respective reports stated that the lamps had been burning (for the season to which the figures apply) for nearly 2000 hours in each case. The figures for No. 1 district, of course, include the cost of the 59 electric incandescent lamps (arcs having been purposely omitted). But it will be seen that, in all three cases, there is a wide difference in the costs and recorded consumptions, and, therefore, we may take it, in the administration—a difference far too wide for districts so close to each other, and which are supposed to be lighted somewhere about the same number of hours. At the same time, only 60 per cent. of the total lamps are fitted with incandescent burners, which means that the full possible efficiency of the whole system is not being attained. Facts of this kind are anything but satisfactory from the gas authority's point of view, and only go to show the further disadvantages accruing, when the latter are excluded from control of the lighting.

In assuming a case in which the public lighting of a district is to be carried out by the gas authority, we may take it that all the lamps will be at once adapted for incandescent burners, straightway aiming at the best possible efficiency and obviating the difficulties arising from the combined effects of variations in pressure and candle power, through the continued mixed flat-flame and incandescents; and, in estimating the costs of a season's lighting, we arrive with a good deal of certainty at the following figures:

An average of 60 lamps should be lighted by one lamplighter, at 15s. per week—this figure to include the time taken up in cleaning, remantling, &c., which, at 36 weeks for the season, is equal to, per lamp	9s. 0d.
Add for mantles used, say four to five	1 0
Do. chimneys or other glasses, say two	0 3
Do. general repairs, glass, and painting	0 9
Total cost of maintenance	11s. 0d.

A lighting table which will meet the requirements of the most exacting local authority can be drawn up, with a total of 1800 lighting hours as a maximum; and taking the consumption per hour per lamp at 4½ cubic feet, this lighting table will provide for a charge of 8000 cubic feet per lamp coming into the rentals, which, with gas at (say) 2s. 6d. per 1000 cubic feet—the price in the above-mentioned cases—brings the total cost of lighting to 31s. per lamp per season. In character and costs of lighting, therefore, a comparison based on some such figures as the above does not leave much doubt as to whether or not the public would be the gainers, so far as concerns the outside lighting, if the gas authority were directly responsible.

The Question of Lighting and Extinguishing.

The lighting and extinguishing of street-lamps by means of torches carried by lamplighters is, despite improvements made over the earlier methods, becoming somewhat antiquated, and any means by which the operations can be carried out simultaneously in the whole or even different sections of systems of street lamps is a favourable step forward in this direction. The many forms of apparatus—clockwork, pressure-wave, or the like—are bidding fair to bring about a revolution in this department, not only through their practically dispensing with the lamplighting staff, but by the fact of their attaining, or even surpassing, the convenience of electricity. These forms of apparatus are, of course, worked in conjunction with the pilot-flame—a fact which perhaps, in some opinions, is sufficient to bring about their non-acceptance, though the continued success of such apparatus in several parts of the country should tend to remove any prejudice. In cost, no objection can be raised against the pilot-flame, as, in a total of 36 weeks, the consumption per lamp does not exceed 1500 cubic feet—calculated from 6000 hours at ¼ cubic foot per hour. The flame can, of course, be regulated so as to consume as low as ⅛ cubic foot per hour; but if the bye-pass fails, the whole system fails, and therefore safety in this direction is imperative. Moreover, it is found that when the flame is of such a size as to consume ¼ cubic foot per hour, it can be counted upon as safe in lanterns which have at least some pretension to being storm-proof.

Some four years ago, a district which I have in mind was fitted out with one well-known form of pressure-wave apparatus—principally as an experiment; and, to be candid, there was from time to time some fun with it. The most extraordinary behaviour of some of the things was at once the cause of much combined anxiety and amusement. While perhaps the majority would be acting properly, a few would fail; at other times, portions of the district would be without light through failure of other of the machines; and even in the daytime it was a more or less frequent occurrence to find lamps which had commenced operations on their own account, and so on. The apparatus was, of course, of

the earlier type. It was found that the wind was partly responsible for the disturbances, though perhaps insufficient margin of available holder pressure had more to do with it. In the summer of last year, the whole sets were replaced by more up-to-date apparatus of the same make, resulting in much more satisfactory working.

Another installation, I may mention, has been recently fitted out with the same type of apparatus, but adapted to the inverted burner; and when, a week or two ago, I inquired as to the working, I was informed that every satisfaction was being given. After some ten weeks of working, during which period, in the early part of November, heavy gales had been experienced, not the slightest trouble had arisen through the apparatus failing to act. The lamps are giving a good and steady light under all conditions, and in no single instance has it been necessary to renew a mantle through being shattered by the wind—showing a distinct saving as compared with the system fitted with upright mantles.

Upright v. Inverted Mantles.

With regard to the relative merits of upright and inverted mantles for use in outside lamps, there seems to be no question as to the superiority of the latter—experience having sufficiently proved this in the case of the two last-mentioned districts. As a further example, I may state a case which has come within the notice of one of our members. On converting a street-lamp from flat-flame to incandescent (upright), the fact was disclosed that the lamp was subjected to almost exceptional buffeting by the winds, resulting repeatedly in a shattered mantle—no less than four being put on in less than two months in the first half of the lighting season. Eventually the burner was replaced with one of the inverted type; and it is a fact that the first mantle lasted the rest of the season. After this, more of the lamps were converted; and recent figures show an average of mantles used over one lighting season in the ratio of 3½ for uprights to 1 for inverteds. In this case, the saving in the mantle bill is quickly compensating for the cost of alterations to lamps.

I trust that the foregoing notes will form some sort of foundation for further brief expressions of opinion and experiences in the time at our disposal. Some points have been purposely omitted, on account of the fact that our thoughts will, later in the session, be turned again to this subject, though there are doubtless many other points which have come within the experience of some of us here to-day, and about which much can be said. These I hope will be freely brought forward now. At all events, if what I have said serves in any way to emphasize among us the unquestionable efficiency and distinct benefits which can be given to the public by the gas industry in the matter of public lighting, through the judicious adoption of some of the many up-to-date systems at our disposal, I shall to some extent have attained my object in introducing the subject. The very name public lighting at once suggests publicity, about which we are hearing so much just now; and surely this direction is one in which we can shine—at least, so far as the observant public are concerned.

Discussion.

Mr. C. Roper endorsed all the paper had said as to the troubles and loss arising from irregularities in metered lamps, which really seemed to have a mysterious knack of getting wrong oftener than the others. They had one which was a notorious offender, and was the more troublesome because it was at least four miles in a straight line from the nearest depôt. Bradford only had this metering system in some of the outlying districts beyond the municipal boundaries. In certain small areas inside the city, they bought gas from private works, and paid for it unmetered. Governor-burners set to pass given amounts were used, and the system had proved for some six or seven years satisfactory to the works selling the gas and to the corporation who bought it. Bradford might seem very conservative in the matter of lighting, inasmuch as their system was a man and a ladder; but it was deemed satisfactory by those responsible. Experiments had been made with some pressure-wave automatic lighters; but the results were wholly unsatisfactory, though the same type worked well elsewhere. A number of representative lamps at various levels in a given district were equipped with them; and though only a small temporary increase of pressure was stipulated for, it was found to be unworkable with less than 15-10ths, and this had to be put on at three works simultaneously. Probably the whole trouble arose from the gas being supplied from several works through different governors—unexpected connected mains often upsetting calculations. Bradford was probably the first town to adopt incandescent lighting for the whole of the street-lamps. At first many were fitted with anti-vibrating arrangements; but the use of these was now discontinued, or at least no fresh ones were put in. A weighted frame was now swung loose from the top of the lantern, and the burner fitted through the centre of the frame, and attached by rubber tubing to a nipple on the top of the service-pipe.

Mr. J. H. Hill agreed that public lighting was one of the supreme chances in which the gas industry might shine, but that it did not always get the chance, owing to the gas undertaking not having a free hand with it. At York, when the Gas Company sought to change from flat-flame to incandescent street lighting, and made a proposition to the City Council quoting extremely low terms for the necessary alterations, their overtures were rejected—almost ignored. Official inquiries were then made as to the likelihood of an electric supply being substituted; but the Electricity Department showed no eagerness to run cables down every street in the city, and consequently matters stood still. After some further delay, the Gas Company voluntarily made the change at their own expense, substituting a No. 3 Kern for the old 5-feet flat-flame burner, and giving 3642 hours' lighting per annum for 52s. 9d. per lamp—*i.e.* about 1s. a week for 10 hours per night. In addition, they provided lamp-pillars, lanterns, mantles, and upkeep. At first, and before all the lanterns had been altered to make them more suitable for use with mantles, the lamplighters were provided with a few of the old burners to get on temporarily, if they found a mantle badly broken when lighting-up. When, after some particularly trying weather, some of these had been fitted along one road, their office was promptly rung up by the City Surveyor, who inquired for their reasons, and protested against the reversion, though the Gas Company had had no encouragement from the Corporation in making the original conversion to incandescent lighting and giving five times as much light for the same price. Along some routes of the electric cars, 50-candle power electric lights had been introduced, which gave so little satisfaction that larger ones were substituted. If the Gas Company made but little out of the street lighting, they were perfectly certain the Electricity Department were losing heavily on these lamps. They had not tried automatic lighters actuated by pressure-waves owing to the predominance of wet meters, to which the extra pressure would probably be inconvenient.

Mr. R. Halkett said they had listened to a paper of great interest. The subject was not one of minor importance, but was the one where gas could secure its best advertisement. He would emphasize the need of care in fixing the height and distance apart of the lamps. It was important that a well-diffused light should be secured, rather than a series of bright areas around the pillars, divided off by dim spaces. Undoubtedly, the gas undertaking was the proper body to be responsible for the public lighting—it could not be in better hands, though district councils often worked it with their our men. Still, a gas company could do a good deal to help, even in these cases. He quoted an instance where a public body had some 2000 lights under their control, and the lighting arrangements met with but moderate success. For some years the gas company were knocking away at the council, and finally got the work into their own hands, and soon had matters in a more satisfactory condition. The lamps were all of them converted to the incandescent type; all the men being taken over first, the "slackers" gradually weeded out, and the others both instructed in their work and kept "up to the scratch" by an inspector who constantly visited all parts of the lighting area. The work of maintenance needed trained and expert men; and those employed by a district council often failed to produce satisfactory lighting, from sheer ignorance of the necessary work. Props were used when too short, and a general idea prevailed that a mere wipe round and an occasional new mantle was all that was needed. Consequently nipples might go untouched for a twelvemonth; and complaints of unsatisfactory lighting that these men reported as being probably due to water in the services, &c., were often found to arise purely from out-of-condition nipples.

Mr. F. Scholefield wished the author had given a few more wrinkles as to fitting up and maintenance, and had told them more widely of day-to-day experiences of the installations. He should like to know if any trouble from naphthalene had arisen in the automatic lighting apparatus, and whether any systematic tests were carried out to see if the burners continued to pass only the estimated amount. He had found governor-floats got rubbed, and so allowed an excess of gas to pass. Their practice was to make out a chart of the district to be lighted, so as to ascertain and insert in the map the pressures found at various points; and then they secured burners adjusted to pass only 3½ cubic feet at these pressures. One class of burners had been tested and found to pass 3¾ cubic feet at 1-inch pressure, 4½ feet at 1½-inches, 5 feet at 2 inches, 5¾ feet at 2½ inches, and 6 feet at 3 inches. He was convinced that one cause of poor lights was the fact of service-pipes to which burners were rigidly attached not being plumb. This was especially so with Kern burners. Often when the lamplighters cleaned them, they failed to place the wheels back in their true positions.

Mr. Garsed, replying to the discussion, thanked the speakers and audience for their kindly reception of his initial effort, and urged other silent members to take heart and gain confidence by his experience. He had as yet heard of no complaints from interference with smooth working of the lighting appliances due to naphthalene. He had listened with amazement to Mr. Roper's statement that only 2-10ths extra pressure had been expected to operate any lighters. He had found an increase of 12-10ths over the maximum to be needed; and the probable cause of their earlier troubles had been insufficient pressure when the lighting-time came round. The lamps had not been lit until gas was well in use in the shops and houses; and by then there had been such a drop in district pressure that the increased pressure put on as a pressure-wave was not ample to satisfactorily operate the appliances. They were now careful to bring it into force soon enough—before other lighting was general. They attached the burners direct and rigidly to the service-pipes, and recognized the need of these being plugged so as to keep truly vertical.

Mr. Cranfield, in proposing a vote of thanks to the writers of the papers, spoke of the value of Mr. Dawes' communication for a permanent reference in the collected "Transactions" of the Junior Associations, and thanked him for going to the trouble and expense of supplying them with copies of the diagrams. It had

been a creditable piece of work—clear, concise, and laudibly free from verbosity, padding, and would-be fine writing. Mr. Garsed's was a timely contribution on a valuable topic from the private company and smaller gas-works' point of view; and the sustained interest of the discussion indicated the wisdom of his choice of subject and his means in dealing with it. The session's programme was a gratifying sign of the readiness of the members to recognize their duty to their fellow members, and a recognition of the fact that, as they had gained by the frankness of many others in the industry, so in their turn any help that their experiences could afford to others was an implied obligation for them to share their knowledge with others.

Mr. M'NAB seconded the vote, which was cordially passed, and briefly acknowledged.

OHLSSON PROCESS FOR PURIFYING COAL TAR.

We learn from the "Chemical Trades Journal" that a Swedish firm has introduced a novel and valuable feature into the treatment of coal tar; the Aktiebolaget Joh. Ohlssons Teckniska Fabrik, of Stockholm, has solved the problem of removing the carbon. The black colour of tar constitutes about one-quarter of the weight of the crude material. As the liquid tar has about the same specific gravity as the solid carbon, the latter remains suspended. The firm in question has succeeded in completely isolating the carbon from the liquid constituents of tar; leaving the latter in the form of a clear, transparent, gold-brown liquid. Such purified tar is evidently much better adapted for fractional distillation than the crude material, and should facilitate the separation of the hydrocarbons and other compounds with a high boiling-point—an operation rendered difficult in the process of ordinary tar distillation owing to the foaming caused by the fine carbon toward the end of the operation. The carbon separated by the Ohlsson process is totally different from lampblack in its physical properties, and is distinctly of a graphitic nature. Details are withheld with regard to the method used for effecting the separation. In all probability, light hydrocarbons are added to the tar to lower its specific gravity, and the actual separation is brought about by the use of centrifugals. The added hydrocarbons can be removed by distillation from the residual liquid tar. Our contemporary says this process is worthy of careful study owing to its possible bearing upon the isolation of the more complicated higher boiling constituents of coal tar.

CHANGING FOUL WATER IN A GASHOLDER TANK.

Readers of the "JOURNAL" may remember that in connection with the American Gas Institute there is a Bureau of Information, to which the members submit questions. It is a standing Committee of seven, with Mr. M. Webb Offutt as Chairman. According to the report presented by them at the recent annual meeting of the Institute, their services are not used so fully as they might be; but the Committee have nevertheless answered seventy questions since their constitution, and an additional ten, sent in during the past twelve months, are dealt with in the report referred to. One question was on the subject of foul water in a gasholder tank near the residential portion of the town; and the inquirer wished to know if there was any way of getting rid of the odour without changing the water. The following answers were given to the question by two members of the Committee.

(1) The odour referred to in the question evidently arises from drip water, which is very hard to overcome. My suggestion in regard to this matter would be to put into the tank approximately one or two (possibly three) feet of water, introduced about 3 feet underneath the surface on the outside of the holder tank through a short pipe or nozzle, which would cause the water to rotate very slowly round the tank, at the same time allowing the water to overflow. This would take off the top of the water for the circumference of the tank; and after this was done, I would suggest using a liberal quantity of the liquid called "germo." Liquid bleach has also been employed successfully. If it did not entirely stop the objectionable odour and complaint, I would just repeat the operation again after a week or ten days. This suggestion has not been practically tried by me; but our companies have used "germo" considerably in killing the odour from drip water in cellars and residential sections, with some success; and it is the best material I know of as a disinfectant for drip water.

(2) A gasholder with a steel tank which does not leak should not give off any objectionable odour, unless some of the water gets on the outside of the holder between the tank and the outer lift. This is generally caused by the holder blowing at some time, or getting so near the blowing-point that condensation on the inside will pass to the outside of the lower lift. If the condensation inside the holder reaches a depth that will cause this to occur, steps should be taken to remove it from the interior of the holder to prevent a recurrence of the trouble. All water in gasholder tanks, however, is saturated with gas; and this water, of course, gets between the outer lift and the tank. But, as a rule, it does not give off a very strong objectionable odour,

GAS-FLOW MEASUREMENT BY THE PITOT TUBE.

At the recent meeting of the American Gas Institute, a paper on "The Flow of Gas in Mains" was submitted by Mr. J. W. BATTEN, of Detroit (Mich.), in which he directed attention to the adaptability of the Pitot tube for measuring the volume of gas flowing through mains. The following are some extracts from the paper.

Certain well-known fundamental laws, such as those incorporated in the so-called Pole formula, have finally decided the size of mains and services. The drop in pressure permissible under an assumed maximum consumption, and with gas of a given specific gravity, furnished the criterion by which judgment of the adequacy of a given pipe-line was determined. In the large proportion of distribution systems, almost all mains are ultimately connected with all others, and frequently two or more feeders from the source of supply carry gas to substantially the same territory. In such cases, the break in pressure found over a certain distance gives information which is not only inadequate, but which is frequently distinctly misleading. Break in pressure is caused either by actual demand on the capacity of the main or else by decrease in its effective area due to the presence of water, naphthalene, or other foreign matter. On the basis of such unreliable information, territory might be reinforced where in reality existing lines should amply fulfil the demand. Ordinarily used accurate methods for the measurement of volumes of gas, such as the wet meter, are obviously inapplicable to such a situation. In the same category must be placed the Venturi tube, which, while it offers an accurate method of measurement with simple calculations, it is quite impossible to place in every pipe-line of which the velocity might be desired.

M. Pitot gave his name to a tube which he invented and described to the French Academy of Sciences in 1732, giving to it the formula for falling bodies of $V = K\sqrt{2gh}$, which is also that for Torricelli's theorem for the velocity of issue of water from an orifice. This compact, simple, and accurate measuring device consists essentially of a plain L-shaped tube placed in, and directed against, the flow of the fluid. Where the flow to be determined is that of the liquid, the velocity is a measure of the height h of the liquid in the tube above static level. The very simplicity of the device prevented its general acceptance as a measuring apparatus of merit; and it was not until about 1850 that D'Arcy, a French hydraulic engineer, applied it directly to the measurement of the velocity of the flow of water, and discovered it to be an instrument of precision which supported Pitot's original contention that the correction factor was unity and unvarying.

The first application of the tube in a form modified from that employed for liquids was made by Professor S. W. Robinson, of the Ohio State University, in 1873. Since he published his results, in 1886, a large number of ingenious and interesting experiments have been performed, establishing the accuracy of the tube.

The distribution system on which the Pitot tube was to be used consists briefly of dumping gas from medium pressure distributor mains into the low-pressure system by regulators, coupled with a small proportion of the output distributed direct from holders. It was found advisable to measure the amount of gas passing through some of these at various seasons and at peak load, and was intended to be continued with a view to assisting in the determination of the size and character of main extensions. It was recognized at the outset that the velocities found in low-pressure mains would lie probably between 5 and 20 feet per second, whereas almost all the work done in this connection has been with velocities considerably greater—up to 200 feet per second. This condition would require either a very sensitive gauge or a tube of which the value was much less than unity, or both. The first tube tried was of the traditional form; but it was soon discarded, as it could not be readily introduced into the main. Moreover, it had a value of approximately unity, and in conjunction with a 10 : 1 gauge gave a reading so low as to introduce considerable error. Effort was then concentrated on securing a gauge sufficiently sensitive and reliable. It had also to answer the requirement of being readily set up in the street. The well-known principle of the Segur gauge seemed to offer the best solution, and a gauge of the standard type was made up; various combinations of liquid being used in an attempt to find two of which the surface tensions were sufficiently far apart to prevent mixing, and which, on the other hand, possessed a specific gravity nearly enough alike to satisfy the condition of delicacy. After trying anise-seed oil with water, and various gravities of kerosene with alcohol, it was found impossible to obtain a satisfactory working meniscus between the two liquids separated in gravity by less than 5 per cent. Any less differential produced an indefinable meniscus when either side of the gauge was subjected to an impulse of pressure. This was evidently the limiting condition of practical sensitiveness of the gauge; and, as greater delicacy was required, recourse was had to an inclined gauge constructed of $\frac{1}{8}$-inch glass tubing, which, with kerosene of an accurately determined gravity at various temperatures, permitted close observations.

Having obtained a sufficiently sensitive and accurately calibrated gauge, it seemed best to use for determinations a tube giving the widest manometer deflections for a given velocity. Tubes having static and impact pressure openings, with many others were tried, and the combination shown in fig. 1 was the one finally selected,

Tubes requiring a large tap in the main to permit of their entry were rejected, as it was hoped to use the tube on the street in the manner shown in fig. 2.

The procedure preliminary to making a determination is as follows: The main is exposed and tapped for a 1-inch standard pipe; the inside diameter of the pipe being carefully measured. The presence of water or sediment is noted with its amount; this restriction of area being taken into account in the calibration. The 1-inch pipe is run to the surface of the ground, capped, and surrounded with a gate-box. When ready to make the traverse, the 1-inch cock B, to which the stuffing-box A is attached, is screwed on, and the tube inserted into the main by opening the cock.

Fig. 1.

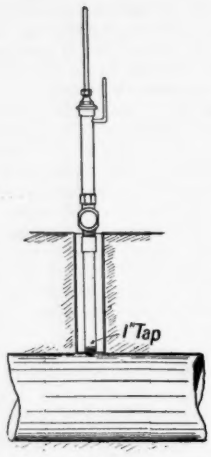


Fig. 2.

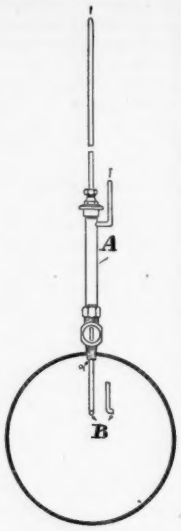


Fig. 3.

The value of K in the equation $V = K\sqrt{2gh}$ was obtained by placing the tube in a 24-inch main in series with a tested wet meter. The diameter of the main being accurately determined, the tube was inserted into it through the stuffing-box. The main was divided into six or more equal concentric areas, and a forward and backward traverse made; pressures being taken at the centre of each annular ring, which pressure was assumed to be a measure of the velocity throughout that ring. The number of rings into which the main may be divided may be increased to any desired extent with some slight increase in accuracy. However, in a 16 or 24 inch main, twelve readings on each traverse give a reliable average. As the square root of the readings is proportional to the flow, the average velocity is obtained by averaging the square roots of the readings obtained. [A specimum calculation is appended to the paper.] After a number of determinations and observations were made on the street, opportunity presented itself to calibrate the tube at other velocities and in other mains. It was found that, while the Pitot tube itself accurately shows the velocity head *plus* the static head, the variation in aspiratory effect on the static end, with the velocity, changes the value of the factor. In short, increased velocity at actually constant static pressure decreases the reading of static pressure shown by the tube, and *vice versâ*. Evidently, then, a tube which has a value of unity, unchanging, must be used wherever there is no method of arriving at the correct velocity.

The discovery of the variable character of the value of K for changing velocities led to the production of the tube shown in fig. 3, which has been found to have a value of 1·01 at all reasonably low velocities, up to 20 feet per second. It is not unlikely that it would be increasingly in error at velocities above this. The static pressure is taken from the 1-inch tap at the edge of the pipe where theoretically the velocity is zero. This form of tube and gauge offers a method of easily making frequent tests at the same point, with no exposure of the main after the first determination of its internal diameter is accurately made.

Other applications of the principle may be found, two of which will be sufficient for illustration. Two 16-inch lines from Station A of the Detroit City Gas Company carry gas under regulated holder pressure through two parallel streets one block apart into the downtown section two miles away. On one occasion, at peak load in the evening, when local pressure was somewhat increased at the station, a serious oscillation was noted at the regulator manholes at two streets. This regulator at the time, however, was not passing gas, due to back-up from the two low-pressure mains connected to its outlet. Obviously, the oscillation was due to water in one or other of the low-pressure lines. Recording gauges installed at suitable places seemed to point to the presence of water at a certain place about midway between the source of supply of gas and the spot where the oscillation was first noted. No water, however, was found. Practically no services were taken off these lines where the oscillation seemed greatest, so the main was tapped for taking, over a considerable distance, simultaneous U-gauge tests. This test did not develop anything, as all oscillations appeared of about the same amplitude. The Pitot tube placed on the line disclosed that, looking at the oscillation of pressure on the static pressure-gauge, at the moment when the pressure increased, the differential on the tube decreased—*i.e.*, when the pressure increased, the rate of flow decreased; showing conclusively that our observations were being taken between the source of supply and the stoppage. It was then merely a matter of tapping the main in a few places, finally arriving at a point where the drop in static pressure coincided with the increase in the flow. The water was finally found at a point where a line running out of the 16-inch main, and into which the latter drained, had been cut off and capped some years previously—no drip having been put in. Undoubtedly the carrying capacity of this main had been seriously interfered with for some time; but the presence of other sources of supply prevented its discovery until it was practically full of water. Had a tube been placed on these two lines simultaneously, the wide disparity in the quantity of gas carried would have been at once noted and a reason sought.

The other application is one in which not only a Pitot tube but any differential which remains constant for a given flow of gas, and varies in a known way, may be used. Medium high-pressure pumping lines from Station A, reach a total distance of some 8½ miles. The requisite pressure to keep regulators at the end of the line in operation was maintained by the station operator, whose instructions were to follow a predetermined chart, which was changed as often as circumstances seemed to warrant, but usually about once or twice a month. Invariably, however, the pressure maintained had to be sufficiently high to deal with sudden storms or unusually dark or cold days.

It occurred to Mr. F. L. Cross, who at that time was Assistant-Engineer of the Detroit Gas Company, that, as a definite relation must exist between the amount of gas being pumped and the drop in pressure from the pump to the end of the line, it should be possible, after calibration, to predict this fall in pressure, knowing the drop through a given proportion of the distance, or, what would be more feasible, through a Pitot tube. Unfortunately, he was unable to remain to carry out his suggestion, which has been subsequently worked out to a satisfactory conclusion.

To discover whether the velocity of output at the plant was a measure of the drop in the total high-pressure line, a Pitot tube was inserted at the outlet of the exhausters, accurate readings being taken simultaneously every two minutes of (1) the static pressure at the station; (2) the Pitot readings at the same place; and (3) the static pressure at the place where the pressure was ultimately to be maintained constant. These results were plotted, and from a consideration of them, it is evident that each increase or decrease in output shown on the tube is reflected in the difference of the two static pressures. It is not to be expected that they would coincide or constantly remain the same distance from one another, since the differential shown by the tube is a measure of the square of the total outflow, while the difference of the two static pressures is a measure of the sum of the squares of the amounts going out through each regulator on the way—only a small amount of the total output finally reaching the end of the line. This led to the placing of a tube at the inlet to the exhausters in permanent position; the tube being one which would give the widest deflection possible with a given flow. This was piped to a suitable sensitive differential pressure-gauge, immediately beside which was a delicate mercury static pressure-gauge—both under the eye of the operator.

The pressure which it was desired to maintain throughout the hours of the day and evening was from 12 to 14 oz. To calibrate our installation, a water pressure-gauge capable of holding a pressure of 2 lbs. was placed 8½ miles off, and the observer was instructed to telephone to Station A every twenty minutes a record of the pressures he took every five minutes. In the meantime, readings of the flow and static pressure were taken every five minutes at the station, and pressures kept there as far as possible so that the desired pressure was maintained at the end of the line. The operation of the installation proceeds as follows: Assuming that the flow-gauge reads 71, and the static gauge 200, adjustment is perfect, and the operator is assured that the pressure at the end of the line is about that desired. Assuming also an increasing load, the pressure at the point 8½ miles distant falls slightly—a fall which is at once reflected in a fall of the static pressure at the station, since the positive pressure pumps continue to deliver the same amount of gas. For this reason, the flow-gauge remains constant, and the operator notes that he no longer has the proper balance. He gradually increases the speed of the exhausters, increasing at the same time the static pressure and flow, but increasing the former more rapidly than the latter, until finally—at, for example, a flow of 105—he has a static pressure of 240, when the conditions of equilibrium are again established. On decreasing the load, the exact reverse of this procedure is followed. It is undoubted that changes in the location of the consumption of large volumes of gas will affect the results obtained by following the chart; but as these changes are slow, they can easily be taken care of by re-calibration.

The following is a sample calibration:

In case where the volume of gas passed is known, and it is required to find the value of K:

$$V = K\sqrt{2gh}$$

where V = velocity of gas in feet per second
K = the desired constant
g = acceleration due to gravity
h = the cubic feet of gas of the pressure, temperature, and degree of moisture saturation of that in the main under test, which

is sufficient to deflect the manometer the amount noted on the pressure-gauge.

Barometric pressure	29·55 in.
Static pressure	0·65 in.
Temperature in main	76° Fahr.
Moisture saturation—not taken, assumed to be	60 p. ct.
Rate of flow per hour shown by wet meter .	151,370 feet

A forward and backward traverse of the main was made, during which twelve readings were taken each way. The square roots of these were averaged, resulting in an average reading of 1·014 inches of kerosene on the 49·4 : 1 gauge.

Sp. gr. of gas at 76° and 29·55 inches	·422
Diameter of pipe	24¼ in.

Inches of water differential at 4° C. =

$$\frac{1{\cdot}014 \times 0{\cdot}781}{49{\cdot}4}$$

Sp. gr. of gas at 81° Fahr. and 30·2 inches is . .	·435
Weight of one cubic foot of gas 60 per cent. saturated with moisture at 81° Fahr. and 30·2 in. bar.	0·03122

Then h in feet of gas of the quality measured is

$$\frac{1{\cdot}014 \times 0{\cdot}781 \times 62{\cdot}425 \times 144}{49{\cdot}4 \times 1728 \times 0{\cdot}03122} = 2{\cdot}605 \text{ feet}$$

$$V = K\sqrt{2gh}$$

$$= K \times 8{\cdot}02 \sqrt{2{\cdot}605}$$

$$13{\cdot}13 = K \times 8{\cdot}02 \times 1{\cdot}613$$

$$K = 1{\cdot}013.$$

TESTING SULPHUR IN PURIFYING MATERIAL.

One of the questions put to the Bureau of Information of the American Gas Institute at the recent annual meeting was: "What is the best method of determining the total sulphur in purifying material?" The following was the answer given in the report of the Bureau submitted at the meeting.

If a Parr bomb calorimeter is available, the quickest and most satisfactory method is as follows: Thoroughly mix half a gramme of the finely-divided oxide with a like quantity of "c-p." benzoic acid. The sample thus prepared is then placed in a Parr bomb calorimeter, and 1 gramme of finely-powdered potassium chlorate and 10 grammes of sodium peroxide added. The whole is stirred with a glass rod until thoroughly mixed. After closing the bomb and placing it in water, the mixture is ignited with a heated iron slug or by electric current, according to the type of bomb at hand. After combustion is completed, dissolve the contents of the bomb in hot water, wash out carefully into a 400 c.c. beaker, and filter off the precipitate. The new clear solution is neutralized with hydrochloric acid, and finally made slightly acid with hydrochloric acid. Bring to a boil, and precipitate the sulphur trioxide with barium chloride (15 c.c. of 10 per cent. barium chloride solution). The beaker is left standing in a warm place until the suspended barium sulphate has precipitated, and it is then filtered off over a small filter-paper, and well washed with hot water until free from barium chloride and sodium chloride. If a drop of silver nitrate solution placed in a small quantity of the washing remains clear, no more chlorides are present. The filter-paper is then dried and finally burnt in a weighed crucible until perfectly white. The total weight of the crucible and precipitate, *minus* the weight of the empty crucible, is the weight of the barium sulphate, which multiplied by 0·137 gives the percentage of sulphur in the barium sulphate. From this, the percentage of total sulphur in the oxide is calculated according to the formula:

$$2 \times 100 \times 0{\cdot}137 \times \text{weight of barium sulphate.}$$

If a Parr calorimeter is not available, the following method may be used: Half a gramme of the finely-divided oxide is digested in 50 c.c. of fuming nitric acid. After half of the acid has evaporated, add gradually about 2 to 3 grammes of potassium chlorate, take down to dryness, and bake for an hour. After cooling the beaker, add 30 c.c. of dilute hydrochloric acid (half acid, half water) and digest, bringing it to a boil. Then dilute to about 100 c.c. and boil. After boiling for about five minutes, filter, add to the clear filtrate barium chloride, and continue as above.

Lunge, in his "Technical Methods of Chemical Analysis," gives an excellent method which is very short, but requires a little more apparatus: From half to one gramme of the finely-divided oxide is weighed out in a porcelain boat, and then placed in a glass combustion tube drawn out at one end, and connected with a Liebig absorption bulb or Meyer's sulphur bulb (the so-called ten-ball bulb) containing either hydrogen peroxide or bromine water. After the boat is placed in the tube, the other end (not drawn out) is closed with a cork stopper (no rubber stopper should be used), and connected with a holder containing oxygen. Heat is applied under the tube where the boat is placed, and oxygen passed through the tube very slowly (about 1 litre in 15 minutes), and then the train swept out with air. The sulphuric acid absorbed in the absorption bulb is transferred to a beaker; titrated with standardized alkaline solution (1 c.c. = 1 c.c. N/10 H_2SO_4), and the results calculated. The reaction is as follows: The spent oxide contains sulphur most likely in three different forms—some free sulphur, and some combined with the iron as iron sulphide (FeS) and pyrites (Fe_2S_3). The oxygen passing over this heated mixture oxidizes all the sulphur into sulphur dioxide; and this passing over the hydrogen peroxide is oxidized to sulphuric acid (H_2SO_4), according to formula:

$$H_2O_2 + SO_2 = H_2SO_4,$$

Bromine water has the same effect. The formula, however, is a little more complicated:

$$2H_2O + 2Br + SO_2 = H_2SO_4 + 2HBr.$$

The hydrogen peroxide method is preferred by most chemists, as it does away with the offensive bromine odour; but a larger excess must be taken to assure accurate results. A correction must also be made for the acidity of the hydrogen peroxide. The entire determination can be made in about thirty minutes.

If only free sulphur is desired, the method is as follows: Treat one gramme of the dry sample in a Soxhlet extracting apparatus with purified carbon bisulphide, taking care to have the sample enclosed in two thicknesses of filter-paper, folded into the shape of a funnel. Continue the extraction until all tarry matter is extracted, as evidenced by the solution running colourless. Distil off the carbon bisulphide; and when all odours of it have disappeared, the flask is weighed. The increase in weight represents sulphur and tar. The sulphur is separated as follows: Treat the sulphur and tar in the flask with about 25 c.c. of pure concentrated red fuming nitric acid, and warm gently at first, and allow to stand until all particles of sulphur have dissolved. It is a useless waste of time to hurry the oxidation; for if a high temperatureis employed at first, the sulphur will be melted into globules, which in this condition are very difficult to oxidize. After all the sulphur is dissolved, add about a gramme of potassium chlorate (the amount depending on the tar present) in small quantities at a time, in order to destroy all organic matter, which if allowed to remain may interfere with subsequent operations. Evaporate with concentrated hydrochloric acid till all chlorine and nitrous fumes have disappeared; taking care, of course, that the solution is not allowed to go to dryness. Take up with water, filter off any residue, and precipitate the sulphur with barium chloride. Wash, ignite, and weigh as barium sulphate. The barium sulphate multipled by 0·1373 will give the percentage of sulphur.

WATER-WORKS MANAGEMENT.

This subject was discussed in a paper read by Messrs. Easton Devonshire and William Matthews at the meeting of the Institution of Water Engineers on the 9th inst. It was a voluminous paper, and was accompanied by ten illustrative plates, most of them of considerable magnitude, as such things usually go. Seeing that the paper occupied 35 octavo pages, we cannot do more than indicate the nature of the contents.

In their prefatory remarks, the authors said that it would be generally admitted that the official responsible for the management of water-works must, at least, possess such knowledge of water-works engineering as will ensure his dealing, in an intelligent manner, with such matters as the economical utilization of the sources of supply, the reduction of waste, the maintenance of structural works, mains, and machinery, the filtration or treatment of water, laying of pipes, services, and fittings, and the handling of labour. The need for such knowledge presents itself in every department of management other than that of pure accountancy, and makes it essential that the chief officer of a water-works undertaking should have been trained as a water engineer. Such training alone, however, will not make a good manager, but must be supplemented by the possession of sound commercial experience. Public water authorities and companies alike are becoming alive to the value of men in whom are combined a sound knowledge of engineering and of business; and, the authors venture, in view of this fact, to impress upon younger members of the Institution the necessity of qualifying in both departments.

The suggestions which the authors then put forward are of general application, but must, obviously, be modified to meet special circumstances, according to whether the undertaking be large or small, and whether administered by a public authority or a company. They first advise that the administration should be under one roof and one chief officer, subject only to the control of the governing body. This system is predominant among companies, and even where some of the secretarial and accountancy work is done apart, such division of responsibility is there unattended with ill-effect, because the control is centred in a single board, before whom all chief officials appear, and by whom all differences are adjusted. When, however, the undertaking is large and in the control of a public authority, there are, almost invariably, one or more officials besides the engineer or manager, reporting to other committees than the water committee, each having a tendency to support its own particular officer and obtain a predominating influence in the direction of the undertaking. This condition of affairs is becoming acute, and detrimental to the best interests of the undertakings, and should be checked by councils insisting that such committees shall work jointly, and give equal ear to the representations of all officials concerned. It is safe to say that an impartial investigation would, in many cases, reveal the fact that the cost of administration has increased enormously, and is still increasing, in cases where such divided

control exists. The system is very demoralizing, as the nominal manager of the water department is sorely tempted to relax his efforts towards economy owing to their being counterbalanced by the extravagance in other departments, and because he is looked to as responsible for the gross result of operations of which he has but part control. Many cases could be cited to prove that, although officers and staff are better paid by companies than by public bodies, the result of transfer to a public authority has been to increase the cost of administration.

If sole control by one officer is impracticable, the authority should insist upon the officials acting under a single or joint committee, having their respective duties properly defined. And, to prevent duplication of work, it should be incumbent upon the officials to agree upon the forms of accounts and books to be used, so that, in whichever department they be kept, they shall equally serve the purposes of all concerned. Where agreement seems impossible, the question in dispute should be settled by the one committee, after hearing both officers concerned, and on sound practical and economical lines.

It may be conceded that, in the case of public bodies, the accountants department should be the collectors of all moneys, and should also pay all outgoings (including wages); or otherwise, conduct the internal audit of the manager's accounts. Beyond this, any interference with the control of affairs is unwarrantable and detrimental, as creating a division of responsibility.

After this introduction, there comes a mass of detail dealing with committee and board meetings, and the work associated with them. Then succeed notes on general office administration; and the minute manner in which the subject is dealt with will be gathered by quoting the divisional heads: Correspondence, Order Books, Accounts, Cash-Sheet, Detailed Data, Requisition Book, Time Sheets, Pay-Sheets, Stores Account, Stocktaking. We quote the part on the stores account:

The keeping of suitable stores and stock accounts, while imperative, presents many difficulties; the ideal and theoretically perfect system, which some accountants would insist upon, being, in the majority of cases, practically impossible, owing to the detached character of the operations of a water-works undertaking and the limited capacity of the average foreman to keep anything like satisfactory books or accounts. The more experienced accountants and auditors fully recognize these limitations and seek, by consultation with the managers' department, for a compromise which, while affording reasonable safeguards against dishonesty, is not impracticable, cumbersome, irritating, nor abnormally costly in operation; it being an undoubted fact that, where such a compromise has not been effected, there are cases where pounds are being expended to detect the just possible leakage of pence, and the impossible loss of shillings, except through such acts of gross dishonesty as could hardly fail to be traced and detected by less cumbersome means. With little exception, the goods used in a water-works undertaking are neither easily portable nor readily disposed of if purloined. The chief exceptions are brass taps or fittings and lead pipe. Of the former, a stock account is easily kept; and the legitimate use of the latter can be checked and accounted for if issued from a central depôt. But any system, having as its objective the hunting-down of fag ends of pipes and stray tools, is predoomed to failure. The fag ends mostly go, and can always be alleged to have gone, into the lead pot; and small tools do accidentally get lost and buried in trenches, and thus cannot be accounted for.

Stock, of every sort, should be taken regularly, and at least once a year, in such detail that its value can be computed.

In any stocktaking system which can be recommended, the prime cost of each item will, at some prior date, have appeared in the books; but this will not by any means be its proper valuation after the lapse of time. Such value must be assigned to it as is arrived at by applying a regular rate of depreciation—due regard being had to the more or less perishable character of the goods. The authors consider that the system of keeping stock books, and the amounts to be allowed for depreciation, should be agreed upon between the several departments involved, or that in this, as in other cases, failure to agree should necessitate a reference to the administrative committee or board.

Following are notes on records and statistics; foremost place being given to the keeping of an up-to-date and correct record of the underground system of pipes, valves, and fittings, showing upon suitable maps their location, size, and, in exceptional cases, their depth. Then information is given on applications and contracts for supplies. Here we learn that applications to supply any premises with water for domestic purposes should be made on proper forms; and the authors recommend the adoption of the model form agreed upon by the Incorporated Joint Committee on Water Regulations. Upon every occasion, when there is such change of ownership or occupancy that liability to pay the water charges is removed from one person to another, the signing of a fresh application form should be insisted upon. Each application form should state the character and position of the fittings from which water is to be used; and upon the receipt of each, an inspector should be sent to verify this information, and make a thorough inspection to see whether the pipes and fittings are all in accordance with the regulations. Only after the receipt of his satisfactory report should the water be turned on. The application forms constitute contracts, and should bear numbers, assigned to them consecutively, as soon as all formalities have been complied with and the water turned on. The applications accepted during the past month should be laid upon the table at each committee or board meeting, and after that filed in numerical order. Any contracts annulled, or replaced by fresh contracts relating to the same premises, should either be destroyed or withdrawn from the general file and assembled apart. Similarly, application forms or contracts for the supply of water for building purposes, gardens, or trade uses should be numbered and filed in numerical order and assembled separately for reference.

The authors next describe, in considerable detail, the principles, use, and application of the card system, as being well worthy of close consideration by water-works managers. In the system referred to, each card becomes a register of all the particulars of a distinct supply, and only in case of dispute is reference to the application form or contract necessary.

The next section of the paper deals with demand notes, receipt books, and collectors. In regard to the remuneration of collectors, the authors, remarking that it is either by way of commission upon the amount collected or by salary, are of opinion that the latter method is preferable as, in that case, the hours of work can be controlled, and, at times when there is but little collection possible, as at the commencement of each quarter, the collectors may be usefully employed on other work. The collectors should, so far as possible, and occasionally at least, be changed from one district to another; take no part in the making out of receipt forms; bank the money received at least every two days; and be held responsible to account for cash or the production intact of a receipt form for every counterfoil in the receipt book. Under no circumstances should any collector be allowed to alter a receipt form, or accept any less sum than that shown upon the receipt, either as payment on account or otherwise, without the express authority of the manager, given by means of a notice in some prescribed form.

The authors advocate a thorough system of waste inspection. Passing on, they allude to bye-laws and conditions of supply; and in this connection they draw attention to the "Model Bye-Laws and Conditions of Supply" recently issued, as a publication, by the Joint Committee on Water Regulations. Among the new model bye-laws will be found one by which authority is given to the undertakers to fix, for the purposes of detecting waste, an outside stop-cock on every service-pipe, in addition to any stop-cock which is under the control of the consumer—the new one being reserved exclusively to the authority. This power will greatly aid in the detection of waste, by affording means for its discovery, at any time of the day or night, without entering upon the premises, or disturbing the consumer, and will also furnish effective means of shutting off the supply to empty houses, and defaulting consumers, without having to break open the roads.

Following a reference to complaints, and to automatic pressure recorders, we come to the question of meter supplies. Meters, the authors remark, should be read at as nearly as possible the end of each quarter, even if this necessitates the temporary employment of some inspectors who will usually perform other duties. Those connected to very large supplies should have the indications taken more often, (say) monthly, as the failure of any such meter may give rise to dispute and involve claims of considerable importance. Then the subjects of outdoor staff, upkeep of mains, staff at pumping and other stations are discussed. This brings us to the question of capital expenditure.

The subject as to what should, or should not, be charged to capital account is a debatable one of considerable importance, and cannot be lightly overlooked, as it may have a distinct effect upon the financial result of the working of any undertaking; and there is an unfortunate tendency on the part of local authorities, in these days of high rates, to seize upon any pretext for charging to capital account the cost of quite trivial works which the current revenue account ought to bear. The matter is one which should be freely discussed between managers, accountants, and auditors, and a proper balance be struck between the theoretical and practical aspects of a subject full of difficulty. The question frequently arises out of the renewal of mains, originally laid years ago. If the main had broken down bit by bit, the renewal of each part would have been paid for out of revenue; but if, for the sake of convenience, and while portions are yet good and sufficient, it is decided to renew the whole at a single operation, then it is pleaded that the charge should be against capital account. This is further complicated in cases where, for convenience as before, and also to provide for increased carrying capacity, the renewal is made by means of pipes of larger size; then it would appear only reasonable that capital account should bear some part of the charge, and revenue its share, because it will obviously for some years benefit by the lessened cost of repairs due to the newer pipes.

Discussion.

Mr. H. Ashton Hill (South Staffordshire Water-Works Company), referring to the question of the chief official of a water undertaking, said the authors laid it down that there should not be dual control, which was a wise thing. He had wondered for years as to who the chief officer should be—whether the engineer or the commercial man; seeing that in some towns the chief officer was the engineer, and in other towns the secretary. Of course, circumstances altered cases; and in towns where the chief official had grown up in and with the business through a great number of years, and he happened to be the secretary, it would be difficult to induce the powers that be to put a new man who was an engineer in charge of the whole concern. He suggested that the ideal thing was, if circumstances allowed, for the engineer to be the executive head of a water undertaking. But he

had by experience learned this, that the head of such concerns must also be a business man. A man might be an excellent engineer; but if he was not a business man, he would not do to be the chief official of a water-works. Therefore, on top of engineering attainments, there must be commercial experience. It seemed to him there were three zones of official requirement—the engineering and the secretarial, and between these two came management. Sometimes they found that the engineer was the strongest man of business—the best qualified man; and he came out on top. In another case, they found the secretary was the best man; and he became the general manager. So far as he could see, these were the only explanations of the differences in practice in this regard. He had occasionally had a suspicion that in some cases the chairman of a committee or board would encourage a little friction between two officers. At times the committee or board did not define, as they ought to do, the relative position of their officers; and so friction ensued, and the concern was not managed properly. As to the remuneration of the chief officer, a board of directors or a committee ought not to consider just how little they could keep a good man for; but they ought to consider how much they could afford to pay him. The authors pointed to the unsound financial tendency to charge to capital account matters that should rightly be placed to revenue. If a main was renewed bit by bit, it was charged to revenue; if it was entirely renewed (the authors said), some people pleaded that it should be charged to capital account. He (Mr. Ashton Hill) had never heard of such a plea. If a main had to be renewed, and the original cost had been placed to capital, he did not see why there should be any temptation to put it there again. There ought properly to be a depreciation account from which the cost of the renewal of the main could be taken. Where there was an enlargement of a main in addition to renewal, the only and proper method was to charge to capital the cost over and above the original cost of the displaced main.

Mr. George Greenslade said he adopted the card system in connection with the South Hants Water Company. In this case, the system was only used as an index to the general rent-roll; but if, by the use of the cards, they could do away with the general rent-roll, he could understand there would be a considerable saving in the amount of labour. He did not think the engineer and manager of a water undertaking should be burdened with much book-keeping. He believed the system of paying collectors by salary was on the increase.

Mr. R. Askwith (Weardale and Consett Water Company) considered that meters should be read every month. As to charges against capital or revenue for replacements, if a pipe was replaced by one of equal size, the whole cost should be charged against current revenue, because it only put them in the same position as when the pipe was originally laid. If it were replaced by a larger one, which cost £500 as against (say) £200 for the original pipe, then only £300 should be charged to capital, and the £200 to revenue.

Mr. T. Reader-Smith (Kettering) remarked that the authors pointed out that control by a local authority did not always lead to economy. Sometimes it did; and Kettering was a case in point. Respecting charges to capital, he pointed out that most local authorities were subject to Local Government Board audit; and the auditors were very keen as to what was charged to capital. But generally as to the relaying of mains, and the charging of it to capital or revenue, it seemed to him that the case of a local authority was somewhat different from that of a water-works company. Loans that the former raised had to be repaid regularly, so they were not in the same position as to outstanding capital as a company.

Mr. L. C. Walker (Reading) observed that his water inspectors took washers for taps with them on their rounds, and this saved a good deal of leakage and delay.

Mr. A. B. E. Blackburn (Sunderland and South Shields Water Company) mentioned that he also had monthly meter readings. With regard to inspection, he considered there was a good deal of time lost in having to go through the formality of sending written notices from the office with regard to any waste that might be going on. His waste inspectors acted as their own clerks. The practice in his case was that an inspector always washered taps free of charge. If there was any waste going on which was not due to a faulty washer, the inspector asked the tenant if he was willing to pay for the repair; if he was not, the inspector went at once to the landlord.

Mr. W. Jones (Pontypridd), speaking of the life of meters, said that Mr. Rodda, of Eastbourne, had prepared a form which was very valuable in keeping meter life records. In the form there was set forth the whole life of a meter from the time that it was purchased.

Mr. H. C. Head (Winchester), Mr. J. F. Cullen (Deal), and Mr. H. Preston (Grantham) contributed to the discussion. The last-named mentioned that, in his case, meters took more than half the supply; and he found it necessary to have two or three of the largest meters read daily.

Mr. J. S. Pickering (Cheltenham) and other members spoke; and then the President mentioned the usefulness, in pipe-laying, of employing a small hand force pump for testing for soundness. Plans of the whole pipe system ought to be very carefully kept up to date.

Both authors commented upon the discussion, which, with the reading of the paper, occupied the time of the meeting for two-and-three-quarter hours.

CORRESPONDENCE.

[We are not responsible for opinions expressed by Correspondents.]

Trades Disputes Act and Labour Union Conspiracy.

Sir,—This Association have been requested to furnish particulars of any instances which gas companies have experienced of intimidation of their workmen, with the view of incorporating such particulars in a statement which is now being prepared for presentation to the Prime Minister.

I am directed by my Committee to ask you to be good enough to allow me, through you columns, to request any gas company who have experienced such intimidation to forward me particulars thereof at their earliest convenience.

Fred. E. Cooper, Secretary,
Gas Companies' Protection Association.

5, *Victoria Street, S.W., Dec.* 15, 1911.

International Smoke Abatement Exhibition, 1912.

Sir,—We have read with interest your editorial reference, on p. 742, to the proposed Smoke Abatement Exhibition, and the attitude taken up by the Society of British Gas Industries.

As members of the Society, and of the Gas-Stove Section, we can definitely state that no meeting of the Society, or of the section named, has been called to consider this question. We think it is against the wishes of many of the members of the Society that an attempt has been made to shelve the Smoke Abatement Exhibition.

Influential members of the Council may have come to the conclusion that it is not in their interests that makers of apparatus, embodying up-to-date features, should have an opportunity of showing their manufactures under the auspices of the Smoke Abatement Association; but, as a firm making apparatus for gas cooking and heating, we are fully convinced of the desirability of bringing home to as many members of the public as possible the merits of gas, as compared with other forms of heating and cooking.

R. & A. Main, Limited,
Per A. P. Main.

Princes Street, Oxford Circus, W., Dec. 14, 1911.

Professor Lewes and the Burgess-Wheeler Investigations.

Sir,—I have read with interest the valuable summary of knowledge regarding the composition of coal, contained in your report of Professor Lewes's Cantor Lecture in the "Journal" for Dec. 5.

There are several points in the summary which may be liable to create a wrong impression. I refer more particularly to the work of Messrs. Burgess and Wheeler, of which frequent mention is made. An examination of their original papers will show that they advance, among other things, the main theory that ". . . one type of compound in coal, and the most important type, is a degradation product of cellulose. This type . . . we identify with the 'hydrogen-yielding constituents' indicated by our experiments with coal. The 'paraffin-yielding constituents' are most probably derived from the resins and gums originally contained in the sap of the coal plants, and form the cement of a conglomerate, of which the cellulose derivatives are the base."

Professor Lewes appears to dissent from some of Messrs. Burgess and Wheeler's minor conclusions, and to go to some length to discount them. For instance (p. 689), referring to the residue obtained by Messrs. Burgess and Wheeler on extracting coal with pyridine, he says, "leaving a coke-like residue, which, on distillation, yielded hydrogen and oxides of carbon (*they would have found methane as well if they had looked for it*)." The implication of carelessness—to say the least—on Messrs. Burgess and Wheeler's part is scarcely fair to them, particularly as their original paper states ". . . yields as gases *mainly* hydrogen, carbon monoxide, and carbon dioxide."

It would be quite evident to an impartial reader of Messrs. Burgess and Wheeler's papers that their conclusions are perfectly compatible with the results of their experimental work, which proves that there is a striking difference between the relative amounts of hydrogen and methane evolved below 750° C., and above that temperature. That there is a total absence of one or the other is, of course, not the case; nor is total absence necessary to the soundness of their argument.

Professor Lewes criticizes Messrs. Burgess and Wheeler very freely; but it is noteworthy that his criticisms are all on minor points, and are unsupported by experimental data, whereas the main theory put forward by Messrs. Burgess and Wheeler, as quoted above, is practically that adopted by Professor Lewes himself (as he says twenty years ago, although I have not yet been able to find any previous reference to this).

It is, however, evident from your report that in whatever degree Professor Lewes may differ from Messrs. Burgess and Wheeler with regard to subsidiary issues, he is in agreement with them on the main question; and in justice to the latter able investigators, I think attention should be directed to it.

Arthur Forshaw.

Birmingham, Dec. 14, 1911.

Gas-Furnaces and the Daily Press.

Sir,—Until I read p. 744 of your last issue, I was fairly optimistic of being able to obtain your encouragement; but I confess that the words used by you thereon almost make it appear impossible. Let me, in fairness to myself, say that the article on gas-furnaces was written after a great deal of inquiry into the matter. Then it was shown, in proof, to two most important individuals in the gas industry (it would be unfair to name them, lest they, too, incur your ridicule). They approved of all that was said about the furnaces. You make it appear that certain facts were deliberately withheld. "He omits notice of the fact that the experiments also extended to electricity."

This fact was quite unknown to me, and was never hinted at by those gentlemen when the proofs were read. "But there is one not mentioned"—also not discovered during the searches and certainly not mentioned to me, though fairly obvious when the matter is raised.

You then proceed to deny the truth of the words—you call them "senseless and untrue"—which read "in the past the gas engineer has lived outside the circle of engineering." Here you quite misinterpret the motive and the words. How many contributions by gas engineers to the ordinary engineering literature, other than to their own specialized journals and societies can be quoted? Why should not a gas engineer be President of the Institution of Civil Engineers, as have in the past electrical engineers? I simply wrote those words because I think that it would be a most excellent thing for the gas industry if all engineers knew more about what is happening in the development of gas, as they know what is happening in the development of electricity. I maintain that the ordinary civil or mechanical engineer seldom looks at the gas journals, seldom hears about gas engineering, while he is constantly up against electrical engineers. My words are not concerning mechanical engineers, but rather of men of the type in the gas industry such as Sir William Preece, Mr. Alexander Siemens and others connected with the electrical engineers.

Now about the Institution of Electrical Engineers. It is cheap and easy to sneer. "Practically anyone who calls and professes himself to be an electrician has in that Institution a class in which he can find entrance." You have shown, yourself, that the members and associate members outnumber the members of the Institution of Gas Engineers. As for the personal reference—that is not worth notice. Several years ago, the gas journals printed a contribution made by me (before I was the "Engineering Correspondent") to the Institution of Electrical Engineers. It is fair to assume that if it was worth while space in the gas journals as well as the electrical papers, it was worth reading before the members of the Institution. You might scoff at the Institution of Mechanical Engineers, and say that even the Editor of "Engineering" was allowed to be a President. That does not lift technical journalism. It is not my privilege to be on the staff of a technical paper, although in the past it has been my lot to edit two that are well known. The work done by the technical writers for the press is most valuable. Your journal, Sir, does valuable work in aiding the development of the gas industry by reprinting papers and technical contributions. You and I are not fully agreed concerning the accuracy or interpretation of certain figures; that presents no excuse for me to say that you should, or should not, be a member of a certain Institution. As for the reference to the great journal whom you affect just now to despise (having previously talked of its influence and circulation)—well, it is not worth while attempting to defend it.

I have not looked carefully through the names of the members of the Institution of Gas Engineers; but I merely venture to add that there is every indication that the numbers of that Institution will increase—as they should, and as I hope they will. If, as you say, there are practically 706 gas engineers and managers out of a total of 843, then it seems clear that the sub-managers do not join the Institution. Why? Are there no sub-managers?

There is only one point which I wish to make here. When I had the opportunity, some years ago, of becoming "Engineering Correspondent" to the journal which it is my privilege to serve, the one thing which made me desire the honour was the belief that it would be possible, by the work done, to influence the public to a better appreciation of the value of the work of the engineer and his status. Although, long before the Publicity Scheme of the Gas Institution was suggested, I have attempted from time to time to show the public how the use of gas will solve the smoke problem, though I have done my best to point out the importance of applied science work to this country, I have only on one occasion—so far as I can bring to mind—received any communication from any member of the gas industry. That was from a Past-President of the Institution of Gas Engineers—a desirable communication, well worthy of the man. I have had dozens of letters from electrical engineers, and from all other classes of engineers; but gas engineers have not, in the slightest degree, until this correspondence arose, attempted to communicate with me. They appeared to be absolutely indifferent to what was being done on their behalf. Even in connection with the furnace article, the initiative was mine entirely. In order to protect myself against the sharp criticism in the "JOURNAL" which I felt might follow any statement by me concerning gas-furnaces, I made, in all, three journeys across London to interview the men actively engaged in the work. Despite the fact that the gas industry has never in any way really encouraged my work, I was willing to devote time and trouble to explain to a numerous circle of readers what the industry is doing with regard to furnaces. My only reward in connection with the article has been ridicule and severe criticism at your hands. Can you wonder that I doubt whether you really do view my work with any sympathy, and whether you will do anything constructive rather than destructive? It is so easy to tear down; why not exert a little energy to building up? I am, as I have repeatedly said, desirous of getting closely in touch with the industry which you claim to represent. I am sanguine that I shall succeed; indeed, a great deal of time has been spent in the endeavour. I cannot see, up to the present, that you have made it easier for that to come about. It is surely right for me to ask whether you really think anything could have been fairer to the industry than the course I adopted with regard to the furnaces?

I have purposely withheld a further letter on the lighting question, so that I may at once make this explanation and find out really whether you always mean to use your pen for destructive criticism. If so, my time would simply be wasted in attempting to continue the correspondence.

"ENGINEERING CORRESPONDENT" OF THE "DAILY TELEGRAPH."
Dec. 15, 1911.

[If there is one thing we should regret more than any other, it would be to do anything that would induce "Engineering Correspondent" to decline to justify the so-far neglected parts of his original "Golden Lights" article, and to communicate his promised reply to our criticism of his defence so far as it has been carried. Therefore, we will not deal at length with the foregoing letter. But an explanation is required, as "Engineering Correspondent" appears to be under a misapprehension. The article criticized last week was headed "Gas-Furnaces." But only part of it dealt with that subject. Other questions were dragged in, about which our friend, it appeared to us, was insufficiently informed; and we attempted to give him some particulars which we thought would be useful. If he had kept to the subject of the heading of the article, there would really have been nothing to criticize. But when he, dealing with industrial gas-furnaces, accuses gas engineers of having lived outside the circle of engineering, asserts that among them there is a tendency to imagine that engineering is unnecessary, and makes a bald comparison of the membership of the Institution of Electrical Engineers and of that of the Institution of Gas Engineers, he must expect his statements to be challenged, if there is substantial ground for challenging them. He surely must see that it is not the way to invite encouragement, by arrogating to himself the position of judge and censor of the gas industry, its men, and its doings, without possessing any adequate internal knowledge of the industry, its men, and its doings. We quite agree that "it is cheap and easy to sneer." With regard to the gas engineering profession and the Institution of Civil Engineers, the number of gas engineers who are members and associate members of that body is much greater than "Engineering Correspondent" imagines It is too big a task to wade through the lists to ascertain the number. On the Council of the Institution of Civil Engineers the gas industry is represented by Mr. H. E. Jones; and Mr. Walter Hunter (another member of the Council) is a Director of the Commercial Gas Company. At the time of his death, Sir George Livesey was on the Council. The late Mr. Thomas Hawksley was for four consecutive years President of the old British Association of Gas Managers. Mr. Charles Hawksley has been President of the Institution of Civil Engineers; and he is a member of the Institution of Gas Engineers. His son is a Director of the South Metropolitan Gas Company. Many Directors in the gas industry are members of the Institution of Civil Engineers. Regarding the Institution of Gas Engineers and the junior members of the profession, "Engineering Correspondent" is not aware that the membership of the junior gas engineering organizations of the industry is round about 850. There we will stay our hand, with the assurance to "Engineering Correspondent" that the last thing that we desire is to see him break from his promise to deal further with the matters mentioned in the opening lines of this note.—ED. J. G. L.]

The Whole Truth, and Nothing but the Truth.

In the editorial note attached to "Not Good Enough's" letter in last Tuesday's issue, there appeared the statement that for the lower offer, for the outside flame-arc lamps in question, it was proposed by the Electricity Department concerned to give a slightly higher candle power than the high-pressure gas-lamps. This was, we understand, quite correct; but the mistake was made in the argument of applying this extra candle power to the original offer of flame-arc lamps. This resulted in the erroneous statement that "the second electricity offer shows that it was proposed to give more current for much less money." By reference, however, to the original electrical offer, it will be seen that, for the outside lighting, an illuminating power of 12,500 candles was mentioned, as compared with 10,000 candles by the high-pressure gas-lamps [see candle powers and prices *ante*, p. 597]. Therefore, "a slightly higher candle power" than the proposed high-pressure gas-lamps would not mean the consumption of so much current as for the 12,500 candles under the original electrical offer. But the difference does not seriously affect our main argument as to the large reduction in the price offered. Supposing that the difference in the candle power offered was 2000 candles, and that we liberally give the lamps credit for developing 3 candles per watt, this would mean approximately 700 watts per hour, and a difference in the consumption per 1000 hours of 700 units, which would not contribute much, at any price charged per unit for outside shop lighting, towards the £32 difference between the first and the second offers. However, comparatively small though the mistake is, we regret that it occurred. With this modification, the argument as published last week stands.

Tiverton Gas-Works' Manager's Salary.—It was decided by the Tiverton Town Council yesterday week to increase the salary of Mr. Clark Jeffery, the Manager of the gas-works, by £20 per annum. Several members of the Council spoke of the excellent results achieved under Mr. Jeffery's management. Mr. Deering said that formerly they received only £9 per annum for their ammoniacal liquor; but, on Mr. Jeffery's advice, sulphate of ammonia plant was put down at a cost of £400. It had been working one month, and for the first consignment of sulphate they had received £100. Mr. Ian Amory pointed out, as an improvement in another direction, that the quantity of gas made per ton of coal had increased from 9000 to 11,500 cubic feet.

Bradford and a Municipal Coal Supply.—At the meeting of the Bradford Corporation last Tuesday, Mr. Cowling moved a resolution to the effect that it be an instruction to the Finance and General Purposes Committee to appoint a Special Sub-Committee, consisting of the Lord Mayor and nine members (three members from each party on the Council), to consider and report during the next six months upon the question of the desirability or otherwise of establishing a municipal coal supply; and that expert advice be obtained if necessary. The mover pointed out that there was such a difference of opinion with regard to this matter, that it would be distinctly advisable to have an authoritative report either for or against the proposal. The motion was carried.

REGISTER OF PATENTS.

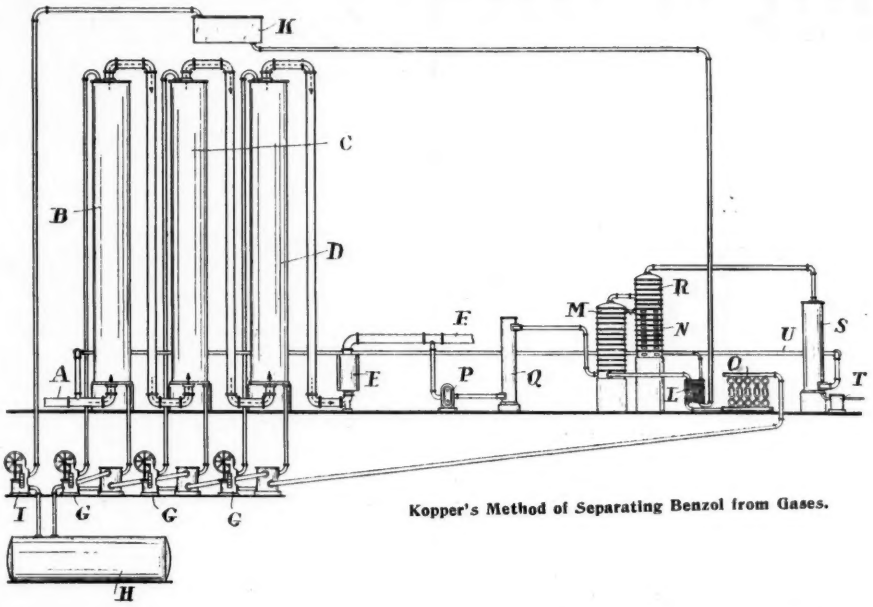
Treating Washing Oils Used for Separating Benzol from Gases.

KOPPERS, H., of Essen-Ruhr, Germany.

No. 12,251; May 20, 1911.

As stated by the patentee, a known method of separating the constituents of mixtures of oils and the like having different boiling points, consists in passing gases through such mixtures, at different temperatures, so that the gases become saturated with the several constituents—the latter being re-separated from the gases by condensation, enabling the gases to be used again. "A circulating quantity of gas can in this way be used again and again, for separating mineral oils, tar, and the like, practically without loss."

The present invention is based on recognition of the fact that peculiar circumstances attend the application of this method to the separation of the oils used for washing benzol out of coal gas. In the process of separating mineral oil, tar, and the like, residues occur, which are then removed from the process; whereas in the case of the washing oils, the separated oil is required again for the separation of benzol. The patentee has found that if washing oil from which the benzol has been removed wholly or in part in the distilling column is brought into contact with the circulating gas, the cooling applied (in the known method of working) for separating the constituents absorbed by the gas is not sufficient to separate all the benzol—the gas remaining saturated to a degree depending on the lowest temperature reached. The proportion of benzol corresponding to this saturation is higher than the proportion of benzol in the gas to be washed; so that when the separating gas enters the separator, the oil takes benzol from it and carries it forward. This does not involve any loss of benzol—the processes being performed in cycles. But the efficiency of the oil for washing purposes is reduced; and larger apparatus is accordingly required.



Kopper's Method of Separating Benzol from Gases.

According to the present invention, this disadvantage is obviated by providing that the separating gas is also washed, to separate benzol, before it enters the separator; so that the washing oil is not supplied with benzol by the gas. By this means complete regeneration of the oil can be effected, which is of great importance in view of the high dilution of the benzol in the gas to be washed. For the purpose of the invention, the cooled gas is treated in a separate small washer with cooled oil; the latter being then added to the oil which has been used for the main washing process.

The process may be further simplified and "perfected" by using, instead of a separate circulating quantity of gas, a portion of the washed gas, which is then returned to the main gas-stream in front of the washers. This ensures that there is no loss of benzol on entering the distilling column, and no loss after the treatment in the separate washer. The gas used for separating need not necessarily all pass through the main washers, if several are used—it may be led into the last of the series.

By suitably proportioning the quantity of gas supplied per unit of time to the separating apparatus, the temperature at which the separation is effected may, it is claimed, be reduced as compared with prior processes, in which temperatures of 120° C. and more have been used. The washing oil consists of distillates of tar, capable of oxidation and tending to polymerization. The oxygen in the main gas-stream is in part absorbed by the oil; so that above 120° C. resins are formed, and the oil becomes useless—involving considerable expense for renewal. In the present invention, the possibility of producing the vapours at partial pressure allows of greatly reducing the absolute temperature; so that the disadvantage referred to is removed or greatly reduced.

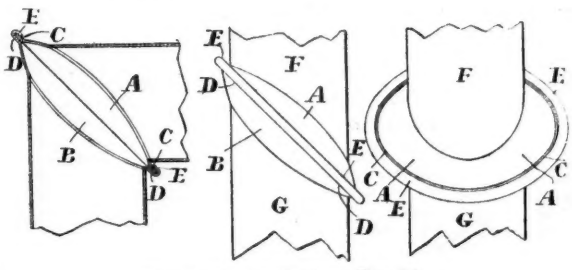
Apparatus suitable for carrying the invention into effect is shown. A represents a pipe through which the gas, coming from a cooler, is conducted to the series of benzol washers B, C, D, whence it passes through an oil-separator E to the pipe F. The oil for washing out the benzol is forced into the washers by pumps G; the cleanest oil being brought into contact with the gas having least benzol. The oil saturated with benzol is forced by the pump I from the drum H to the elevated tank K; and thence it flows to the distilling apparatus. It first goes through a heat transfer apparatus L, in the opposite direction to a stream of washing oil coming from the distilling column M. The saturated oil is then further raised in temperature in a heater N; and then flows through the distilling apparatus back to the heat transfer apparatus L, and thence to a cooler O and to the pumps G. A suction pump P takes a portion of the washed gas from the pipe F and forces it through a heater Q to the distilling column, and thence to the return-flow cooler R. The gas, thus saturated with benzol, is then treated in a cooler S, which separates some of the benzol; and the gas is then returned to the pipe A in front of the benzol washers.

Elbow or Bend for Metal Pipe Flues.

GLOVER, THOMAS, of Edmonton.

No. 4902; Feb. 27, 1911.

This invention relates to elbows or bends for metal pipe flues constructed with angled flanged ends—the flange of one end being turned over the flange of the other end to hold the two pieces of tubing together and yet allow of their being moved at an angle to each other. The object aimed at is to construct such bends or elbows so that all bolts and screws are dispensed with.



Glover's Adjustable Stove Flue-Pipe.

The inventor forms two dish-like appliances A B, having a circular rim or edge C D—D being formed with an overlapping edge E or prongs for engaging and enclosing the edge C of A—so that when the two are placed together they can be made to revolve about each other. A B are each formed with a hole around which the angled or curved cut edges of a short length of piping F G may be connected, or the holes may be formed by stamping, so that the portion pressed out forms means to which short lengths of piping can be riveted. It is thus possible to bend the flue to any desired angle to suit the position of the stove and the hole in the chimney or the direction the piping has to take when in position.

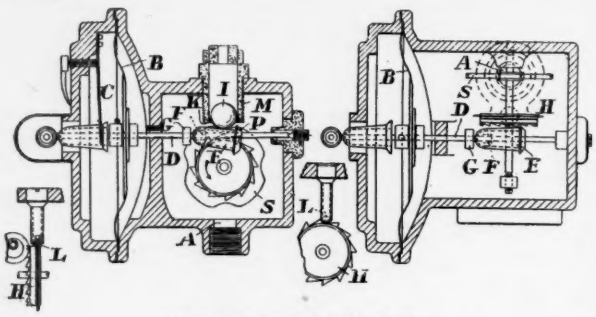
Distance Controller of Gas-Valves.

KÖRNER, E., of Coblenz-Lutzel, Germany.

No. 17,055; July 25, 1911. Date claimed under International Convention, March 1, 1911.

In distance gas-valve controllers as heretofore constructed, the patentee points out, the transmission of the impulse through the diaphragm or plunger bell to the control wheel was effected by pawl-and-ratchet mechanism; but, in practice, it was found that "these parts often failed to act, owing to impurities in the gas, or rust from the pipes, causing them to become clogged and to become displaced readily, resulting in derangement."

In the present invention, the control ratchet is constructed as a body rotatable about its longitudinal axis. It surrounds the diaphragm spindle, and has (with regard to it), besides a rotary movement, also a pendulous movement corresponding to the depth of the ratchet tooth. In this way, the effect of wear of the engaging surfaces of the controlling pawl is practically eliminated, because the pawl automatically rotates to a small extent around its spindle at each operation of the mechanism, and can, if desired, be readily turned by hand, so that new parts of the engaging surface can be brought into operative contact with the ratchet-wheel. On the other hand, this design of controlling organ ensures easy operation of the controlling mechanism, because "the capacity for rotation of the pawl around its longitudinal axis allows for the changes of the effective leverage resulting during the gradual ascent of the tooth at the time engaged, which might otherwise cause undue friction and possibly jamming between the pawl and ratchet wheel."



Korner's Distance Gas-Controller.

The gas for (say) an upright burner enters through the channel A into the casing and to the rear of the diaphragm B, which is balanced by an adjustable blade spring C. A spindle D is attached to the diaphragm; its ends being in suitable guides of the casing, so that defective working (owing to the spindle shifting laterally) cannot take place. On the spindle is a hollow conical pawl E loosely mounted on, and rotatable about, its longitudinal axis, and in longitudinal section on each side of its axis this takes the shape of a pawl—*i.e.*, the cone is provided at its base with a small annular lip or rim P, which serves as a pawl tooth. The pawl is prevented from moving axially on the spindle towards the right by a collar F, and towards the left by a collar G. In addition, the pawl has a pendulous motion similar to that of a bell; the collar being designed as a ball-pivot and engaging (with some play) in a corresponding socket made in the interior of the pawl. This latter motion enables the pawl, as required, to swing sideways to the extent of the depth of the corresponding teeth of the ratchet-wheel, while the rotary movement serves to minimize the results of wear and "bring about a free and frictionless action of the control mechanism." The ratchet wheel H, which works in conjunction with the pawl, is provided with two different sets of teeth—namely, on the front side-ratchet or "crown" teeth, with which the pawl engages with its annular lip P, and other teeth on the periphery of the ratchet-wheel which serve to prevent backward rotation of the wheel, by means of the rising and falling ball L [see details], which is somewhat smaller in radius than the depth of each of the teeth with which it engages. The valve-ball I is located in a bore of the casing M on the valve-seat K. It is actuated by the cam wheel S by means of gently rising cams thereon.

With the apparatus in the condition represented, its operation takes place in the following way: If a pressure impulse takes place, the diaphragm B moves to the left. The collar F of the spindle D then carries with it the pawl E, so that, owing to the engagement of the lip P with the crown teeth of the ratchet-wheel, the latter is turned to the extent of one tooth in the direction of the arrow. The falling ball L at the time engages with the oblique surface of the particular ratchet tooth then passing beneath it; and on the completion of the stroke of the pawl, it drops behind this tooth into the next succeeding tooth-gap. At the same time one of the cams of the wheel S lifts the ball-valve I off its seat. This lifting, however, "takes place very easily, because (deviating from known designs) it is assisted by the gas-pressure." During the stroke of the pawl, the latter is free to adjust itself automatically and correctly, owing to its rotating and swinging movement; "so that a gentle, free, and frictionless motion of the control mechanism takes place." When the pressure impulse stops, the diaphragm B, with the spindle D, returns rightward to normal position under the influence of the spring C. The pawl E is then carried along by the collar G. Owing to its pendulous suspension, the pawl, with its lip P, rises during the return motion out of the corresponding crown tooth; the ratchet-wheel H meanwhile remaining stationary, because the ball L prevents the backward rotation of the mechanism.

Birmingham Gas Workers' Wages and Holidays.—The Birmingham Gas Committee on Monday last week received a deputation of the workmen of all grades employed in the gas-producing departments. They were introduced by Mr. Simpson, the General Secretary of the Gas Workers' Union; and they explained that they appeared before the Committee to support the employees' memorial for higher wages and an improved arrangement as to holidays. The advance asked for varied from 4d. to 7d. per day for workers in the retort-house, and an equivalent of 2s. per week for all labourers. Application was also made for a week's holiday annually for all men regularly employed, in addition to the Bank Holidays, and holidays for short service men *pro ratâ*. The advances in wages were asked for owing to the increased cost of living and the new methods of gas manufacture now adopted, which it was contended justified the revision. Upwards of 2000 men are affected by the memorial.

LEGAL INTELLIGENCE.

GUNNING'S AUTOMATIC STREET-LAMP LIGHTERS.

Action for Alleged Infringement of Patents.

Last week the hearing of an action (commenced the previous Friday) was concluded by Mr. Justice Warrington, in which the validity of Gunning's patents for automatic street-lamp lighting was in question. The title of this action was "British, Foreign, and Colonial Automatic Light Controlling Company, Limited, and John Gunning *v.* Metropolitan Gas-Meters Limited."

The plaintiffs claimed an injunction to restrain defendants from infringing letters patent of 1899 and 1908 for improvements in apparatus to automatically light and extinguish gas-lamps at predetermined times and for improvements in conical plugs. Plaintiffs relied principally on the first patent. Defendants denied infringement, and also pleaded that the invention was not new, by reason of prior publication. At the conclusion of plaintiffs' evidence, his Lordship dismissed the action with costs. The facts of the case are sufficiently stated in the following

Judgment.

His Lordship: This is an action for infringement of letters patent; the invention said to be covered by them being described as improvements in apparatus for automatically lighting and extinguishing lamps at predetermined times. It is a patent dated 1899. The object of the patent is fairly stated in the title. The object is to automatically turn off a gas-lamp, or a series of gas-lamps, and automatically to turn on the gas at a particular time. Except that it is applied to this special purpose, it is very much like the contrivance in an ordinary alarm clock. The arrangement itself as described in the specification (I will come to the words of it directly) consists of a clock-dial, not fixed as an ordinary clock with revolving hands, but turning itself; and the dial is fixed on the spindle attached to the spring of the clock. There is no intervening gear except, of course, the escapement gear. This revolving dial is divided into twenty-four parts; and it is furnished with two arms, which can be adjusted to any one of each of the hours in the day—that is to say, to a post-meridian hour for the purpose of extinguishing them. The arms are, of course, made adjustable; otherwise they would be useless. They can be fixed to any hour—first by loosening a screw pin and lifting it from one of the holes with which the dial is pierced, and then dropping it into the hole opposite. The effect of loosening the pins by which the arms can be adjusted, if they are both loosened at the same time and taken away together, is that the revolving disc gets divided into two discs, one of which is fixed on the spindle while the other is loose. The object of being able to loosen one of the two discs—making up what I have previously described as the clock-dial (the revolving disc)—is to enable the person who wishes to deal with the instrument to set it as he would set a clock. The practical way of working it is that if he comes (say) to 2 o'clock and wishes to set the machine so that the lamps will be lighted at (we will say) 6 o'clock, and to be extinguished at 4 o'clock in the morning, he can put his arms so that the pin on the one side runs through the hole against which is the figure "6," and he can put the other pin through the hole against which is the figure "5." This, of course, by itself would not do. He wants a further adjustment, because you must see that the arm is to come round to the place where it is wanted at the hour at which it is set—that is to say, in the one case at 6 o'clock. Accordingly, you must see that your clock dial is so fixed that in its return the arm will reach the required point at the particular hour. I will suppose he goes at 2 o'clock. He may find that this contrivance is slow; and I will suppose it is an hour slow. If it is slow, he will find that at a line opposite the star-wheel, which is to be operated by the arms on the dial, will be the hour "1," not "2." He will then turn the dial till he gets the "2" opposite that point. If he does so, the arm will pass the same four hours later, and will come into operation when required.

I have only mentioned all this because this is the only object I can find of having what has been called a loose disc and a fixed disc. If this clock were always as it is now—just one revolving dial—you would have no means, unless some other means were provided, of setting it. The way it operates on the gas-cock is that the arm in its revolution catches a projecting tooth of an eight-teeth wheel; and it is moved (bear in mind) very, very slowly indeed, because it only goes round once in twenty-four hours. In its motion, it presses on the tooth of the eight-teeth wheel, and gradually moves it as it passes, with the result that it moves the clock inside one-eighth of a revolution, opens a passage through it from the pipe which is charged with gas, and lets the gas pass through the burners as is wanted. An exactly similar operation takes place when the other arm comes round, turning in another one-eighth of a complete revolution, and shuts the gas off. That is all. In order, of course, to preserve a means of lighting the gas, there is a permanent bye-pass, by means of which a little jet of gas is kept alight. That is all the actual thing.

Now let me see how it is described in the specification, because one has to look at that to see what it is that the patentee claims as his invention. First of all he refers to the stopcock, with passages through it, and the plug. He then goes on:

I effect the turning movement of the stopcock or switch by means of clockwork such as that of an eight-day clock, which will go a week or more with one winding up; and I adjust parts of this clock to act on the stopcock or switch so as to partly turn it at the hours to which the parts are adjusted, as I shall describe, referring to the accompanying drawings.

Then (missing one or two paragraphs which are general descriptions of the drawings) I go to line 26: Referring first to figs. 1 to 4A, is the case of a "clockwork of any known kind." That is important. It is: "The case of a clockwork of any known kind, arranged like an ordinary eight-day clock to work for a week or more with one winding by applying a key to the arbor which is timed to make one revolution in twenty-four hours." If that means, as I am inclined to think it does

mean, that the arbor is timed to make one revolution in twenty-four hours, then it indicates, in this part of the description at all events, that the patentee is suggesting that his particular clockwork will have no intermittent gear. It is quite possible to read "which is timed to make one revolution in twenty-four hours" as meaning that the clockwork—the entire thing—is timed to make one revolution in twenty-four hours. It would be equally appropriate. The next thing he says is: "On this arbor is fixed a disc." That does make clear what was not made clear in the previous paragraph—that in this description he intends the disc to be fixed to the winding arbor, because he says: "On this arbor is fixed a disc"—that is, a fixed disc—"to which is loosely held by clamps another disc which has in it twenty-four screw-threaded holes marked with two sets of numerals—each from '1' to '12,' indicating hours. The disc is centred, but free to turn on the arbor; and so also are two arms each of which has through it a screw with a milled head to be turned by the finger and thumb." These screws are merely the means by which the arms can be fixed on to the free disc. Then he goes on to describe the gas-cock on the bracket with a star-wheel having eight arms: "Through the plug there are two passages, crossing each other at right angles. The plug has also a groove, which is always in communication with the supply part, and with a passage provided with a regulating screw, and leading to a pipe which communicates with small kindling jets—one at each lamp. The passage of the stopcock leads to a pipe which communicates with the main jets of all the lamps." This is the whole of the description. Then he proceeds to describe the mode of operating, which I have already described in my own words. Then there is a long description of a modification by which a part of the lamps can be extinguished, leaving another part alight, to be extinguished at a later hour. But for the present purpose, I need not trouble about that part of the specification.

I now come to the claim: "Apparatus for automatically lighting and extinguishing lamps at predetermined times, comprising clockwork operating with one winding for a week or more, on its spindle revolving once in twenty-four hours a fixed disc and also a free disc and a free pair of arms with setting-screws adapted to fix the arms in different positions on the free disc and to clamp the free disc to the fixed disc; a stopcock or an electric switch having on its plug or spindle; an eight-armed star-wheel and suitable passages or contacts, substantially as described with reference to figures 1 to 4." Then there is the second claim: "Apparatus modified substantially as described with reference to figures 5 to 9 for lighting lamps of two sets extinguishing those of one of the sets before those of the other set." In my opinion (and in expressing this opinion I think I am only adopting what Mr. Swinburne, if he had been competent to say so, would have said, judging from what he did say in reference to the facts), this invention discloses specific mechanism for the particular operation required; and but for the fact that the combination is for the specific mechanism, there would—having regard to the state of knowledge—have been nothing in the patent. I will just illustrate what I mean, There had been a great many contrivances for lighting and putting out gas-lamps by cock one way or another. They fell under two main heads, in one of which the operation (in what I may call the main clockwork) was at a certain hour to release an independent motor and allow it to work. That was one. There was another class in which the main clockwork actuated directly the contrivances which were to work on the tap. If I am to read the specification as covering all means whereby clockwork may mean all kinds of clockwork by which such an operation as this can be done, the specification is plainly too wide. It is capable of being read in a wide sense; but I do not think it would be fair to the patentee as at present so to read it. But if this concession is to be made to the patentee, he must take it with the inevitable consequences in reference to the case of infringement.

I take this as a claim for this specific mechanism, which is, I think, the only way in which I can take it. What has the defendant done? The defendant has an apparatus for the same purpose. So far as purpose is concerned and the main nature, it is all quite the same. He has an apparatus for the same purpose. His apparatus works in a way I will describe—leaving for the moment the dial, the operation of which is, except so far as the question of the free disc and the fixed disc, and so on, is concerned, perfectly common. Putting this aside for the moment, his apparatus acts in this way: His revolving disc is furnished with two arms, which can be set to any hour of day or night. It is a twenty-four hour dial as before. The arms are fixed in this case, not by means of pins running through the holes, which effect an absolute fixing, but they are "friction tight," as Mr. Swinburne described it—sufficiently tight to perform the duty they have to perform, sufficiently loose to enable them to be moved by the finger and thumb. Then as they come round towards the hour at which the apparatus is wanted to act, there are two little pins fixed into the base of what I call the movable arm, and one of these pins comes in contact with a cam fixed on to a bent lever. The cam was a curved side; and round this curved side the little pin, moved, of course, by the clockwork, travels. As it travels round, it raises the lever, which has a weight on the end of it. It raises the lever gradually as it pursues its journey until the pin comes to the end of the little curved side. The lever has on it an arm movable with a projecting pin, which engages with the ratchets of a ratchet-wheel. There are eight of these ratchets in the wheel. As the lever, with the weight at the end, is raised by the small pin in the way I have described, it gets just to the top of one of the ratchets. At that moment the little pin has reached the end of its journey, the lever drops suddenly, and the weight pulls with it the ratchet-wheel to one-eighth of a complete revolution. The effect of this, first, in the lighting of the lamps (which is one of the things I will deal with in a moment) is to light the pilot lamp. The thing continues to revolve, and in, I think, about an hour after the operation has been performed which I have just described, the second of the two little pins performs exactly the same operation. It pulls over the ratchet-wheel by one further spoke and lights the gas itself. It opens a tap and lets the gas through and lights up. This is the main operation in the defendants' arrangement. The difference between it and the plaintiffs' is that the plaintiff describes a gradual turning of his cock. In the defendants', the operation on the cock is instantaneous in each case—first lighting the pilot, and secondly lighting the main burner. In my judgment that is not merely a colourable difference, but the defendant has made a new combination containing a perfectly distinct element which is not found in the plaintiffs' combination, and one which Mr. Swinburne himself admits is a much better mode of doing that which is required than the mode adopted by the plaintiff.

There is another matter in which the plaintiffs' and the defendants' arrangements differ, and I think again differ most materially. In the plaintiffs' case, as I have already said, you wind the clock by the spindle to which the dial is fixed. Unless you have some means of loosening the dial with the arms attached to it, you would in winding up the clock, be turning the gas-lamps on and off during the process of winding. The reason of this is, of course, that the dial is fixed to the actual winding arbor. The defendants have not fixed the dial to the winding arbor. They have substituted a separate winding arbor. They have fixed the dial to an arbor which is connected with the barrel containing the spring by means of a cog-wheel. They have not got intermediate gear except so far as one cog-wheel with another cog-wheel on the barrel or spring may be regarded as an intermediate gear. But the material change is that they have adopted means by which you can wind the clock, leaving the dial entirely untouched, whereas in the plaintiffs' you would have to remove the dial before you could wind the clock, except you chose to keep turning a great many lamps on a series in the town on and off during the process of winding, which you would not be likely to adopt.

There again, on the facts which have been proved to me, it seems to me that it is not merely a colourable imitation of the plaintiffs; it is an independent and a preferable contrivance. These seem to me to be the two main points in which the defendants' arrangement differs from the plaintiffs'.

To sum the case up, it seems to me that it resolves itself into this, that the plaintiffs' patent, in order that it may be valid, must be regarded as confined to the specific mechanism which is described in the specification. The defendants' is a different mechanism, and is not an infringement; and if the defendants' were an infringement, it could only be made so by making the plaintiffs' patent so wide that it would be anticipated by some of the specifications referred to.

I think the action therefore fails on the ground of non-infringement.

"GASSING" FATALITY AT ROCHDALE.

Different Opinions as to the Cause.

The circumstances under which two workmen lost their lives by being what is familiarly called "gassed" while engaged in the construction of a culvert at Rochdale in June last, formed the subject of an action which occupied the attention of Mr. Justice Lush at the Manchester Assizes on Thursday, Friday, and Saturday last. The plaintiffs were the Mayor and Corporation of Rochdale, who sought to recover from the Trustees of the Rochdale Market Company a sum of £329, money paid as compensation and costs to the representatives of Thomas Harris, one of the men who died from the inhalation of poisonous fumes while working in the culvert. The case for the plaintiffs was that Harris died from the effects of carbon monoxide, which they alleged the defendants turned into the culvert from the exhaust-pipe of a gas-engine working on their premises. Defendants pleaded that the gas was sewer gas which was in the culvert.

Mr. LANGDON, K.C., and Mr. WINGATE SAUL appeared for the Corporation; Mr. W. F. TAYLOR, K.C., and Dr. ATKINSON represented the defendants.

Mr. *J. C. Shaw*, District Surveyor in the service of the Rochdale Corporation, describing what happened on the day of the accident, said that the vapour in the culvert caused Harris and his two companions who were working there to cough. The eyes of the men were watering. In cross-examination, witness said all up the stream there were bleach-works and mills with exhaust-pipes draining into it.

Dr. *Anderson*, Medical Officer of Health for the borough, who made a *post-mortem* examination of the body of Harris, in conjunction with Dr. Melvin, said he came to the conclusion that the man died from inhaling a dangerous quantity of carbon monoxide gas. But this did not appear to be the full explanation, for there was also evidence that Harris had inhaled some other noxious gas. Asked what there was in the appearance of the blood characteristic of carbon monoxide poisoning, witness said the blood was a cherry-red or carmine colour. Nothing was found to indicate the presence of sulphuretted hydrogen or sewer gas poisoning.

Mr. *Harri Heap*, M.Sc., assistant to Professor Delepine, and Chemical Assistant in the Public Health Laboratory at Victoria University, who had conducted a number of experiments in connection with the case, said he did not find in the culvert any gases such as one generally found coming from decomposing sewage matter, neither did he find any trace of hydrogen sulphide in the air. There was a rather large quantity of carbon dioxide in the culvert, and it also contained carbon monoxide. He knew of nothing but carbon monoxide which would cause the cherry-red appearance of the blood which was saturated with it to the extent of from 12 to 15 per cent.

Similar evidence was given by Dr. Sellars, another assistant in the Public Health Laboratory.

Professor *Delepine* was also called on behalf of the plaintiffs. He stated that, after making experiments with gas-engines, he formed conclusions as to the cause of death in the case of Harris and his companion. In his opinion, sulphuretted hydrogen had nothing to do with the deaths, which were caused by the inhalation of carbon monoxide. As the result of his experiments with the gas-engine at Owens College, he found there was always carbon monoxide present; but it varied in quantity. By altering the working of the engine and the valves, he found that sometimes the engine developed so much carbon monoxide that anything exposed to it, or mixtures of it and air, was killed extremely rapidly. When this took place, the air was also irritating to his eyes and throat. He endeavoured to find out the gases which produced these various effects, and found that when the gas was most dangerous it contained upwards of 4 per cent. of carbon monoxide, and

produced impure acetylene, causing a bad smell. The irritant feeling was caused by nitric acid. Professor Haldane had written to him suggesting that these men had died from poisoning by nitrous fumes, but he (witness) had not seen clear evidence of it. He had great confidence in Professor Haldane's judgment, and did his best, in further experiments, to see if he could produce poison of this kind. He was not able to do so; but he got something which partly confirmed Professor Haldane's view, in the presence of nitric acid, which was there to a very material amount. In the large gas-engine at the laboratory, it was present practically at all times; only in very small quantities when it was working normally, but in large quantities when it was not. In his opinion, the men died from the combined effects of carbon monoxide and such gases as might be emitted by a gas-engine.

In cross-examination by Mr. TAYLOR, witness said there were two sources of danger from a gas-engine—one when the load was too large, and the other when there was too little air in the explosion chamber. With a normal load, and a proper mixture in the explosion chamber, there would probably be no danger, especially if the air current was good.

Mr. TAYLOR: Assuming a state of the atmosphere in which there is no wind, the engines would create a draught?

Witness: The gases discharged into the culvert would displace the air, and extend in both directions.

Would not the culvert suck in air from the stream?—No; it might not.

Assuming that it would not do so, would there be any danger?—If the gases were taken out of the culvert, there would be no danger.

Witnesses were then called for the defence.

Professor *Haldane* said he thought the cause of death was probably poisoning by sulphuretted hydrogen. He did not think that carbon monoxide had anything to do with it. Witness gave at some length his reasons for discounting the carbon monoxide poisoning theory of the case. He had been interested in the case long before he was asked to take any expert part in it. He examined the gas-engine to see if any nitrous fumes were given off; but there was no trace of any, either in the exhaust gas or in the air of the culvert into which the gas passed. It was unknown in his experience that persons who died from carbon monoxide poisoning were able to walk about for hours after being "gassed," as these men were said to have done.

Mr. LANGDON: The point where you and Dr. Delepine branch off is that you think the fact that the men were exposed to the air so long would drive out the carbon monoxide?

Witness said that was probably so, if it was there.

Dr. *Craven Moore* gave evidence that the cause of death was sulphuretted hydrogen; and two surgeons from the Rochdale Infirmary said that some blood taken from the workman Collins, who was "gassed" but survived, showed no trace of carbon monoxide. From the colour of the blood they concluded there was a sulphur compound in it.

Mr. *William Thomson*, a consulting chemist, of Manchester, gave particulars of the testing of samples of exhaust gases which he had taken from the defendants' engine in the market. He said that when the engine was working in its normal condition, there was no trace of carbon monoxide found; nor was there any trace or indication of nitrous fumes. He tried the engine working with such an abnormal load that it shook the machinery, and even then the tests only showed 2 parts of carbon monoxide gas per 10,000, which was quite inappreciable, and not dangerous.

After further similar evidence,

Justice LUSH said he should reserve judgment, as he considered the case of the greatest importance, especially in view of the fact that he was asked to decide between most eminent gentlemen.

CLAIM AGAINST THE BILSTON GAS COMPANY.

Dispute in Regard to a Contract.

In the Crown Court at the Birmingham Assizes last week, Mr. Justice RIDLEY had before him an action brought by Messrs. C. & W. Walker, Limited, against the Bilston Gas Company for the recovery of a sum of money detained by the Company as penalties in connection with a contract carried out by the plaintiffs at the Bilston Gas-Works. Mr. VACHELL, K.C., and Mr. JOY (instructed by Messrs. Pinsent and Co., of Birmingham) appeared for the plaintiffs; Mr. HUGO YOUNG, K.C., and Mr. DISTURNAL (instructed by Messrs. Hall, Pratt, and Pritchard, of Bilston) represented the defendants.

Mr. HUGO YOUNG, in opening the case, stated that the plaintiffs carried out two contracts with the Gas Company, and there was no dispute about the accounts, which showed that there was £1040 owing. The defendants said, however, that under the terms of the contracts the plaintiffs had, by their delay, rendered themselves liable to liquidated damages at the rate of so much per day, amounting to £782. To this the plaintiffs replied to the effect that defendants had prevented them from completing their contracts in time.

Evidence having been given by Mr. *W. H. Adams*, the defendants' Engineer and Manager,

Mr. VACHELL submitted that there was no case, on two grounds. In the first place, by reason of the conduct of the defendants, the plaintiffs were, he said, absolved from payment of the penalties. In the second place, the penalties were penalties in the fullest sense of the word. They were not damages, and on this account they were irrecoverable by the defendants. They were endeavouring to get rid of penalties which they regarded as iniquitous; and it would be a crushing blow to manufacturers if such penalties could be recovered. A few more such contracts and the plaintiffs would be undone, while the defendants would make a handsome profit.

Mr. HUGO YOUNG remarked, in reference to the suggestion that the defendants were making a profit out of the plaintiffs, that if plaintiffs would pay the amount claimed for actual damage with costs, they would waive the difference between it and the actual penalties.

Mr. *H. F. Wright*, the plaintiffs' General Manager, gave evidence as to delay in their work, which he said was brought about by the action of the defendants themselves. He denied that there had been neglect or unreasonable delay on the plaintiffs' part.

Addresses having been delivered by Counsel on both sides,

His LORDSHIP said his decision must be in favour of the defendants.

Judgment was then entered for the defendants on the claim, with costs.

On the application of Mr. VACHELL, stay of execution was granted. A counterclaim stands over for decision until the conclusion of proceedings in the Court of Appeal.

THE ALLEGED MISAPPROPRIATION OF GAS AT FALKIRK.

Accused found "Not Guilty."

In the "JOURNAL" for the 5th inst. (p. 704), we reported the conclusion of the hearing, before Sheriff Substitute Moffatt, of the charge brought by the Corporation of Falkirk against Bailie Henry Russell, one of their number, of having, without their authority, used for lighting purposes gas which was supplied to him for power. The facts of the case have been fully recorded in the "JOURNAL." At the close of the address of Mr. J. W. Gibson on behalf of the respondent, judgment was reserved; and it was given on Monday last week.

The Sheriff Substitute reviewed the circumstances which gave rise to the action, and then proceeded to deal with the charge brought against the accused. He said it was not simply one of having made an improper pipe connection, or a connection not authorized by the Statutes of the town, but of making such connection and using the gas fraudulently. After consideration of the whole evidence, he had come to the conclusion that there was no fraud or fraudulent intention on the part of Mr. Russell. Not only did he think that Mr. Russell did not act fraudulently, but he considered he had reasonable grounds for believing he was right. He submitted, in the first place, that he was doing as he had all along done, with, as he thought, the knowledge and consent of the gas officials. Secondly, he thought the use he was making of the gas for lighting in his electro-plating room was incidental to the use of the power, and was necessary for its exercise. Thirdly, he considered he was giving compensation to the Corporation for this use of gas by employing gas for stoves at lighting rates. Finally, he deemed the whole matter to be so trifling as not to be worth serious attention. Having dealt with these several submissions, the Sheriff Substitute said: "Mr. Russell pays a gas account to the Corporation annually of about £100. Is it conceivable that a man paying regularly such an account, a man who is in a large way of business and a magistrate of the burgh, could be so foolish, to put it on no other ground, as to conceive a scheme and lay a plot to defraud the burgh of a sum of money which is computed at 6½d. a year? I have no hesitation in saying that the triviality of the matter in dispute here is a vital element in determining the guilt or innocence of the accused." For all the reasons set forth in his judgment, he, without any hesitation, and with no doubt whatever, found the accused clearly not guilty. He added that he would not pronounce a formal sentence, as it was his intention to find the complainers liable for respondent's expenses.

Theft of Gas by a Former Manager.

At the Stone Police Court last Tuesday, John Holmes, who was for thirty-three years Manager of the Stone Gas-Works, and retired some time ago on a pension, was charged with stealing 14,100 cubic feet of gas, valued at 35s., the property of the Stone Gas Company, between Oct. 5 and the 1st inst. Mr. Watson, the prosecuting Solicitor, stated that the Company did not bring the charge in any vindictive spirit, but from a sense of public duty and as a warning to others. Evidence was given to show that a check meter was fixed in the house next to that of the accused, and that all the gas entering his house was checked. The difference between the two meters was 14,100 cubic feet. Mr. Ashmall, for the defence, said his client did not contest the case, but pleaded guilty. He had borne an irreproachable character for thirty-three years. The offence would probably affect his pension; and in view of this, he urged the Bench to be merciful, and, even though defendant was sixty-six years of age, give him a chance to rehabilitate himself with his friends and the public. Mr. Kitchener (the Chairman) said the Bench had hesitated; but, having regard to the antecedents of the defendant, they would bind him over for twelve months.

Theft of Gas-Fittings from an Unoccupied House.

At the Birmingham Police Court last Tuesday, Thomas Lane, of no fixed abode, was charged with breaking and entering a void house, and stealing brackets and gas-fittings. He pleaded guilty. Mr. Prideaux, who appeared for the Town Clerk (Mr. E. V. Riley) said that a police-constable found that the premises had been broken into, and on examining them discovered that the fittings had been seriously tampered with, and gas was escaping. The constable had to exercise great care to stop the leakage. He left his lantern outside, and turned up the gas-pipe; and eventually the escape was stopped. A detective stated that on the 4th inst., at about ten o'clock in the morning, he saw the prisoner carrying a bundle of zinc. His pockets were bulky, and when asked what he had in them he said "Only some metal." Witness examined it, and found it had the Corporation mark on it. Asked to account for this, Lane said the metal had been given to him to sell for another man, whose whereabouts he did not know. When charged at the detective office, he made no reply. Two days later, witness went to the unoccupied house, and the portions of the gas-brackets and lead piping found in Lane's possession were fixed to the parts still in position. Mr. Prideaux said the Corporation took a serious view of the case, as there were many thousands of pounds' worth of gas-fittings in void houses. Accused was sentenced to three months' imprisonment.

MISCELLANEOUS NEWS.

HAMPSTEAD BOROUGH COUNCIL ELECTRIC LIGHTING.

Estimate Exceeded by £10,000.

The position of the Hampstead Borough Council in regard to the lighting of the streets by electricity is an unenviable one; for in making the change from incandescent gas to the other illuminant the authority find that the estimated cost has been exceeded by £10,000—a sum equal to a rate of 2½d. in the pound. Interviewing some of the members of the Council, a representative of the "JOURNAL" learnt that twelve months ago the Council considered the question of the substitution of their own municipal electricity for gas lighting; and they first tried experiments. The lighting of one street was undertaken; and as the result, according to the figures submitted, was in favour of electricity, a further experiment with ten streets was then embarked upon. The latter trial, as the first, also seemed to show that the change would be profitable. It was next decided to electrically light the whole of the streets of the borough; the sum estimated to be expended on the work being £15,000. To the amazement of the Council, this sum has turned out to be totally inadequate, for the cost has reached no less than £25,000. A report by the Lighting Committee on the position of affairs came before the Council at their meeting last Thursday evening, under the presidency of the Mayor (Mr. G. W. Holtzapffel); but it was circulated among the members of the authority only, and was marked "Private and Confidential."

When the matter came up,

Mr. O'BRYEN said: I wish to move with your consent, Sir, first of all that strangers withdraw. To-night we are considering the action of two of the principal officials of the Council, and the recommendation of the Committee is that their services be retained; and this has to be submitted to you. It is not in the interest of discipline that what is said here to-night should become public property.

Several members rose to second this motion.

Mr. ASHENDEN: I should like to speak on that.

The MAYOR: There can be no discussion on this.

Mr. BUCKLE: Before you put that, Sir, I should like to move an amendment.

The MAYOR: You cannot. Kindly sit down.

Mr. BUCKLE: I want to address the meeting.

The MAYOR: You must not; it will not do.

Mr. BUCKLE: I beg to submit—[interruption]—I respectfully beg to submit to you, Sir, that the amendment I have forwarded to you will prevent all discussion here to-night. The amendment is that it be referred to the Finance Committee—[cries of "No, no," "Order," and "Sit down"]—and the Lighting Committee jointly to discuss the whole matter, and bring up a report to the Council. [Cries of "No."]

The MAYOR: We cannot hear you. You must observe my ruling.

Mr. ASHENDEN: I also wish to speak.

The MAYOR: We can have no discussion. The bye-law distinctly lays it down that this motion must be put without discussion at all. You are free to exclude or re-admit strangers by your vote, and that is all.

Mr. ASHENDEN: I wish to speak on the motion.

The MAYOR: You cannot speak on the motion.

Mr. ASHENDEN: May I respectfully submit——

The MAYOR: No; you cannot.

Mr. ASHENDEN: I protest.

The MAYOR: I put it that strangers withdraw.

Mr. ASHENDEN said he was sorry for the strangers; and he added something to the effect that courage was wanted.

Mr. BUCKLE said he was sorry for "the distinguished stranger in the gallery." [It is understood this referred to a representative of the Local Government Board.]

A vote was then taken, and it resulted in 30 voting for the motion and 4 against it.

Mr. ASHENDEN claimed a division.

No one, however, supported the claim; and the representatives of the Press and the public were then excluded.

The discussion on the report continued until a late hour.

The Finance Committee's Report.

The "Hampstead and Highgate Express" last Saturday said:

The Finance Committee, in reporting upon the estimate for the additional expenditure as presented by the Lighting Committee, stated that £1397 was in respect of 130 lamps in addition to those sanctioned by the Council, and that there was an excess of expenditure in converting the 2229 lamps which were sanctioned, of £8929; making a total excess of £10,326.

With regard to this estimate, the Finance Committee reported as follows:

(1) That the first intimation they received that the estimated cost of the work had been exceeded was on Oct. 11 last, when they instructed the Borough Accountant to report to them on the actual cost; that the matter was, however, at once taken up by the Lighting Business Sub-Committee, who invited the Chairman of the Finance Committee to attend their meetings; that they had been furnished with the report of that Sub-Committee, but had not had an opportunity of considering the details thereof; and that they had therefore appointed a Sub-Committee to investigate and report on the whole matter, especially to inquire how the excess expenditure could have been incurred without the knowledge of the Finance Committee.

(2) That, as regards the amount of £1397, a sum of £2 5s. per lamp per annum would be transferred from the General Rate Fund to the Electric Light Fund in respect of additional 130 lamps, but that no additional revenue would accrue to the Electric Light Fund in respect of the amount of £8929.

(3) That, from the report of the Lighting Business Sub-Committee, it appeared that the total cost was £25,398; that the amount which had been sanctioned for a loan was £15,000, and steps had already been taken for borrowing this amount from Lloyds Bank, in accordance with the resolution of the Council on Nov. 16 last; that a further amount of £10,398 was therefore required, but it appeared very improbable that sanction could be obtained to borrow the amount.

(4) That, in pursuance of the original intention of the Council to pay for the work out of electric light reserve fund, and to repay the same from the revenue fund in eight years, a sum of £1536 had been transferred to the reserve fund up to March 31, 1911, in respect of this expenditure—thus leaving £8862 still to be dealt with. The Finance Committee suggest that this should be borne by the reserve fund and repaid to that fund from the revenue fund by equal annual instalments in the seven years commencing 1st April, 1911; and therefore they recommended that the estimate of £10,326, as detailed above, be approved, and be deemed to be an estimate of cost, debt, or liability within the meaning of section 8 (3) of the London Government Act, 1899.

That the amount of £8862 above referred to be met out of the electric light reserve fund, and be repaid from the revenue fund by seven equal annual instalments; the first of such instalments to be repaid in the current financial year.

THE DECISION.

The same local contemporary adds:

From 8.15 to 11.30 the Council were engaged *in camerâ* in discussing the report given above and a report of the Lighting Business Sub-Committee, copies of which had not been sent to the Press.

The conclusion arrived at by the Council was that Mr. G. H. Cottam, the Chief Electrical Engineer, should be asked to resign, and that Mr. Egerton Sayer's engagement as principal Outdoor Assistant-Engineer be terminated forthwith. Mr. Cottam's salary was £825, and Mr. Sayer's £390 per annum.

The "Hampstead Record" remarks: "This was one of the biggest questions, vital as it is in importance to the ratepayers, that the Council have ever been called upon to face. We understand that at the end of the debate, the Council arrived at the only possible conclusion open to them, and that in consequence those responsible for the position in which the ratepayers have been placed will shortly have to seek fresh fields and pastures new."

The Gaslight Company's Offer in May, 1910.

In our editorial columns, some serious disclosures are made respecting the above matter; and in connection therewith it will be of interest to reproduce a communication addressed to the Council, on May 4, 1910, by instruction of the Directors, by the General Manager of the Gaslight and Coke Company (Mr. D. Milne Watson):

(1) The question before the Council is one exclusively of how to obtain adequate light for the streets at the least cost.

(2) The offer contained in the Company's letter of the 16th of March, 1910, provides—in comparison with the scheme for electric lighting submitted by the Lighting Committee on the 24th of February last—for the more efficient lighting of the streets at substantially less cost.

More Efficient Lighting by Gas.

(3) The Company's offer provides for a guaranteed average light of 60-candle power by inverted burners, in comparison with a nominal maximum light of 56-candle power by metal filament lamps.

(4) The existing upright gas-burners are stated by the Lighting Committee to give only "about 40-candle power." Actual tests in the street show this to be an under-estimate by more than 33 per cent.

(5) It is a matter of general observation that the electric lamps that have been installed give a far less effective light than the existing gas-burners. This is confirmed by tests in the street, which show that the existing gas-burners give twice the candle power of electric lamps.

(6) The proposed inverted gas-burners would give fully 20 per cent. more light than the existing gas-burners. The difference between the inverted burners and the electric lamps would therefore be still more marked than that now to be observed between the gas and electric lamps in Hampstead.

(7) The Company, in their letter of Dec. 20, 1909, offered to fit up a trial installation of about twenty inverted burners for the observation of the Council. This offer has not been accepted or declined. It still stands good. [Inverted burner lamps were subsequently fitted in Buckland Crescent and Belsize Avenue. These were carefully tested on a number of occasions and gave an average light of 77·2 candles. Similar tests of the electric lamps fitted in various parts of the borough gave an average of 46·8 candles. The maximum light claimed for them was only 56 candles.]

(8) If the electric lamps when installed prove inadequate, lamps consuming more current (and consequently of greater cost to the ratepayers—by way of increased loss or reduced profit to their undertaking) will have to be installed.

(9) Briefly, the proposed inverted gas-burners would give a far more effective light than the two 35-watt electric lamps.

Less Cost by Gas.

(10) The Company's quotation per lamp (including cost of installation) is £2 5s. per annum for four years, and thereafter £1 19s. 6d. per annum—average for eight years, £2 2s. 3d. per annum.

(11) The electric light quotation per lamp (including cost of installation) is £2 19s. 6d. for eight years, and thereafter £2 0s. 2d. [see paragraph 18].

(12) On 2000 lamps the difference amounts to £13,800 in eight years. This loss would fall directly on the ratepayers.

(13) If the cost of installation has been under-estimated, a further loss would fall upon the ratepayers, through their electric light profit and loss account.

(14) If the annual cost per lamp has been under-estimated, this further loss would also fall upon the ratepayers, through their electric light profit and loss account.

Cost of Electric Lamps Under-Estimated.

(15) From a careful consideration of the details making up the electric light price of £2 0s. 2d. per lamp, and of quotations recently made

by electric light companies in keen competition with gas, it is believed that this price is at least 20s. per lamp per annum below the actual cost of current and upkeep.

(16) A loss of 20s. per lamp would amount to £16,000 in eight years on 2000 lamps. Such a loss would fall upon the ratepayers, through their electric light profit and loss account.

Summary.

(17) To proceed with the electric light scheme in preference to accepting the Company's offer would result in

A direct loss to the ratepayers of . . £13,800 in eight years;
A probable indirect, but none the less real, loss to the ratepayers of . . £16,000 in eight years,

as well as in the far less efficient lighting of the streets.

(18) Any reduction now made in the terms quoted for electric light could only "save money" to the ratepayers by reducing the revenue derived by them (as owners of the electric light works) from the street-lamps, and would therefore make absolutely no difference to the net financial result to the ratepayers as above stated.

(19) If it be asked why the Company could make the reduction to be observed between their quotations of the 20th of December and the 16th of March, the answer is that the Council having passed a resolution involving the loss by the Company of the whole of their public lighting business in Hampstead, with the subsequent destruction of a proportion of the capital value of their mains and services, and no consequent saving in standing charges, the Directors decided that it was better to suffer a reduction of the profit, and retain the business, than to suffer the greater loss entailed in the losing of that business. Damage of this kind inflicted on the Company, it may be mentioned, entails a reduction in its assessment to the rates in the borough, a loss of profit to the many shareholders who are ratepayers in the borough, and less opportunity to the Company to reduce the price of gas to the general body of citizens.

GAS SUPPLY IN THE SALFORD OUT-DISTRICTS.

Change of Policy by the Salford Corporation.

At a Special Meeting held last Wednesday, the Salford Town Council resolved unanimously to adopt a recommendation of the Parliamentary and Public Trusts Committee to make an application to the Local Government Board for a Provisional Order altering and amending the Acts relating to the gas undertaking, and so avoid, if possible, proceeding with the proposed Bill dealing with the same matters, details of which were given in the "JOURNAL" for the 21st ult. (p. 543). A supplementary resolution empowers the Council to proceed with the Bill in the event of the application to the Local Government Board being unsuccessful.

After the position had been explained by the Mayor, the Town Clerk (Mr. L. C. Evans) read a letter which had been sent to the Town Clerk of Eccles, and to the Clerks of the Swinton and Pendlebury and the Worsley Urban District Councils. Having acknowledged the receipt of a communication from these Councils announcing their intention to promote a Bill in the ensuing session, "containing the clauses settled by Lord Donoughmore's Committee to give effect to the decision limiting the profits of the Corporation in regard to their gas undertaking," the writer proceeded as follows:

I have received a copy of the Parliamentary Notice of your Bill, and you will be aware that the Salford Corporation have also decided to promote a Bill in the ensuing session of Parliament for gas-works purposes; and I enclose a print of the notice of the Bill. It would appear that both Bills will be substantially identical in respect of powers to extend the gas-works, to alter the illuminating power, and to enable the Salford Corporation to borrow further moneys. The main differences relate to the limitation of the profits of the Corporation from their gas undertaking. It seems to the Sub-Committee of the Parliamentary Committee of the Salford Corporation desirable that the expense of the promotion of two Bills for similar purposes should be avoided, if possible; and they think that if the Local Government Board were asked to grant the requisite powers by a Provisional Order (which, as you are aware, is within the powers of the Board), the Board could adjudicate upon the very important matters of principle upon which differences have arisen between the Corporation and some of the local authorities of districts in which the Corporation supply gas. The Board have had considerable experience in such matters, and can consider the principles involved in their general application to municipal undertakings. The Parliamentary Committee of the Corporation will therefore recommend the Salford Council to apply to the Local Government Board for a Provisional Order for the purposes set out in the notice of the Salford Corporation Bill.

I am further directed to say, but entirely without prejudice, that the Sub-Committee are willing to confer with a small Sub-Committee of your Councils as to the desirability of adopting, as a possible basis of settlement, the principle of a division of profits, whereby the ratepayers of districts outside the borough supplied with gas by the Corporation may participate in a share of the profits made by the Corporation by the sale of gas in such districts. If your respective Councils agree to this principle as a basis for discussion, the Sub-Committee will be glad to arrange for a meeting in this Town Hall at an early date.

Mr. PURCELL suggested that consideration should be given to a more rapid reduction of the debt on the undertaking, which he said now amounted to about half-a-million sterling; and he asked if he would be in order if he moved an addition to the proposals.

The TOWN CLERK explained that if the Local Government Board favourably considered the application of the Corportion for a Provisional Order, a draft would be submitted to the Council by the Parliamentary Committee; and this would be the time when the whole matter could be discussed.

Mr. BESCOBY remarked that there was a disposition on the part of the outside authorities to meet the Corporation in regard to the application to the Local Government Board.

The MAYOR: I cannot say that this morning. All that can be said now is that there is a disposition on our part to meet them.

Mr. BESCOBY said he was pleased to hear that "a spirit of sweet reasonableness" had at last taken hold of them. He was very hopeful—in fact, he thought he could prophesy—that the out-districts would now fall into line with the Corporation. He objected to a differentiation between Salford and the out-districts in regard to the price of gas. In his opinion, they had been following out a wrong policy in this respect, and had done their best to alienate the people in the out-districts.

At the suggestion of the Mayor, Mr. Bescoby did not continue his speech; and the resolutions were then put, and, as already stated, were carried unanimously.

Manchester City Councillors' Views on the Limitation of Profits.

The question of the limitation of profits on municipal undertakings was referred to by several speakers at a dinner held in the Manchester Town Hall on Thursday evening, to celebrate the completion of some extensions to the plant at the Stuart Street electricity station of the Corporation.

Mr. Robert Matthews, the Manager of the Armstrong-Whitworth works in Manchester, was the first to deal with the subject. He said he had always felt that it was wrong and unjust to charge more for gas and electricity than would cover the interest on capital and depreciation and renewals. At the present time, owing to the allocation of large sums out of profits in aid of rates, the consumer of gas had to pay the rates for somebody who did not use it. The Corporation should not sanction such a thing; for they were injuring the very people who were trying to produce on the lowest possible basis. About 90 per cent. of the people outside the city did not know that the Gas Department paid £50,000 in relief of rates. All they knew was that the price of gas was a certain figure per 1000 cubic feet.

The Lord Mayor (Mr. S. W. Royse), who responded to the toast of "The Lord Mayor and Corporation of Manchester," expressed the hope that something would be done before long to cheapen gas in Manchester. In his opinion, the Gas Committee would be wise to consider whether they could not afford to sell gas at a lower price than was charged at present. If it was possible to put into the holder gas for lighting purposes at 9d. per 1000 cubic feet, it was clearly possible to sell it at less than 2s. 3d. at the meter. He was not only in favour of a reduction in the price of gas for lighting, but for that supplied for heating and motive power. It was very properly contended that it was not right for consumers to pay more for their gas and electricity when £50,000 or £60,000 was contributed by the departments in aid of rates. In his judgment, this was a wrong policy. A private concern might be entitled to make as large a profit as it could for the benefit of the shareholders. In a municipal enterprise, however, the whole community were shareholders; and to make one section pay more than the cost in order to subsidize another section was not fair.

Mr. G. Howarth, the Chairman of the Electricity Committee, said the Committee did not consider it to be their duty to make large profits in order that money might be handed over in aid of rates; and they proposed a contribution of 1 per cent. on the outstanding capital. But the City Council did not accept this; and, as a matter of fact, the proportion paid this year by the Electricity Department was slightly more than 1¼ per cent.

Mr. W. Kay, the Chairman of the Gas Committee, appealed for reciprocity between the Gas and Electricity Committees. He said it was the earnest wish of the Gas Committee to make reductions all round, but sensible reductions, made with a view to maintaining the stability of the undertaking. He said he was in accord with the views expressed about profits; his argument being that the first duty of the Committees was to provide an article at the most reasonable price.

POWER-GAS CORPORATION, LIMITED.

The Eleventh Ordinary General Meeting of this Company was held at the Westminster Palace Hotel last Thursday—Sir ALFRED MOND, Bart., M.P. (the Chairman), presiding.

The SECRETARY (Mr. Wilfrid Beswick) having read the notice convening the meeting, the report of the Directors, some particulars from which were given in the "JOURNAL" last week, was presented.

The CHAIRMAN, in moving the adoption of the report, congratulated the shareholders on the accounts for the year being the best the Directors had ever presented. Having dealt with the various items and with the financial affairs of the undertaking generally, he passed on to refer to the work done. He said that during the past financial year a number of important installations had been started in different parts of the world; possibly the most important being the large installation of the Birchenwood Colliery, largely for the burning of inferior fuel and the recovery of sulphate of ammonia. They had also taken an extremely interesting contract for the electrification of an important section of the Imperial Railways of Japan. The total amount of the contract was £160,000; and it included gas plant, gas-engines, and dynamos. They had completed a large gasholder for Manchester, the contract for which turned out well both from financial and other points of view. They had almost completed another large holder at Vancouver, British Columbia, and had finished a large steel-pipe water scheme for the Corporation of Calcutta, which was also very satisfactory. He mentioned these matters to show the shareholders the large extension the business had taken in all parts of the world, and that no opportunities were being neglected either by the Directors or the staff to obtain profitable business. Some of those present might have noticed in the papers the formation of the Ammonium Finance Syndicate, in which he was personally interested, and which he hoped would have beneficial results for the Corporation. This concern was formed to take up schemes which could not be dealt with by the Corporation, and to work in conjunction with it. Within the previous few days, they had obtained several rather important orders; and the prospects for the current year looked, so far as one could judge for the moment, satisfactory—the works being well employed.

The VICE-CHAIRMAN (Mr. John Brock, J.P.) seconded the motion; and it was carried unanimously.

Owing to failure of the gas supply, the town of Brecon was plunged in darkness on the evening of Saturday, the 9th inst., and the occupants of houses and shops had to resort to candles and oil-lamps.

MALLOW GAS PURCHASE ARBITRATION.

First Day's Proceedings.

An arbitration, the proceedings in which extended over four days, was opened on Monday, the 4th inst., at the Westminster Palace Hotel, to determine the price to be paid by the Mallow Urban District Council for the undertaking of the Mallow Gas Company. The arbitration arose out of the Council's Act of 1910, which gave them power to compulsorily acquire the undertaking of the Company.

Mr. CHRISTOPHER C. HUTCHINSON acted as Arbitrator. Mr. HONORATUS LLOYD, K.C., and Mr. WILLIAM SZLUMPER (instructed by Messrs. R. W. Cooper and Sons) appeared for the Gas Company; Mr. VESEY KNOX, K.C., and Mr. A. M. PADDON (instructed by Messrs. Lees and Co.) represented the Council.

THE CASE FOR THE COMPANY.

Mr. HONORATUS LLOYD, in opening the case for the Company, said that in 1910 there were two Bills presented to Parliament—one by the Company for the purpose of securing statutory powers, and the other by the Council for authority to compulsorily acquire the undertaking; and the Council's Bill was passed. Section 6 provided that within three months after the passing of the Act the Council should give the Company notice of their intention to purchase; the terms, failing agreement, to be settled by arbitration under the Lands Clauses Acts. The Council had taken a very elastic provision as to the price at which they might sell gas. Section 23 said: "The price to be charged by the Council for gas supplied by them to persons who shall burn the same by meter shall not at any time exceed such price as may be determined by the Board of Trade within one month after the price or consideration for the purchase of the undertaking of the Company has been determined." The Company, so far as he could give any information about it, was some years ago a small Company in straits. Mr. R. Bruce Anderson, of Westminster, had knowledge of the Company from about 1886, because at one time his father was working the undertaking, which had been leased to him by the owners—the Mallow Gas Company, Limited. The lease, he believed, expired in 1885; and as the Company were not then in a position to take over the management of the concern themselves, Mr. Anderson, senior, continued to work it on their account until about the end of the year 1888, when the old Mallow Gas Company, Limited, went into liquidation. The new Mallow Gas Company, Limited—the undertaking with which they now had to deal—was registered in 1889; and again the Company, though carrying on the undertaking, did not, he understood, do very much in the way of rehabilitating it. At last, however, in 1901, the present Mr. Anderson entered into an arrangement by which he became Manager and Secretary of the Company, and advised them in all matters. The terms were that he was to have a salary of £25 a year, and a moiety of all profits earned in excess of the amount necessary to pay 5 per cent. upon the ordinary shares, after paying 5 per cent. on all other moneys raised for the purposes of the undertaking. Mr. Anderson set to work and rehabilitated the Company and the works; and, so far as the improvements and extensions were concerned, they were charged to capital. More capital was raised; and, so far as the amounts might fairly be, they were charged to revenue. The result of it all was that the total capital issued amounted to £6500; and of this £3500 was in ordinary shares, £1500 in cumulative preference shares, and the remainder in debenture bonds. The gas-works were upon three leasehold plots of land; and they were not only able to deal with the whole of the demand existing to-day, but in some material respects—notably storage and purification—there was a considerable surplus of power. The undertaking had gradually improved its position; but it could not be said that the Council had gone out of their way to assist in this. They had from time to time not only charged handsomely for the privilege of opening the streets, but had gone so far as to deduct 12 per cent. from the public lighting account, and, in addition, had charged for every connection made. Further, they had from time to time passed resolutions prohibiting the Company from opening the streets at all. No doubt it was this position which led the Company, in 1910, to endeavour to secure statutory powers. The Company also sold coal; and they did so under great advantage, because they were able in this way to dispose of the large coal, while utilizing the small coal in the works. He understood, however, there might be some question raised as to whether the Council purchased this business as part of the undertaking. There could not be much doubt about this, because it was a business that had been carried on in conjunction with the gas business.

Mr. VESEY KNOX: My point is that it is not within the powers of the Company under the Memorandum of Association.

Mr. HONORATUS LLOYD (continuing) said it could not be urged that the amount spent in respect of repairs and maintenance had not been liberal. Under the circumstances, he submitted that it was a stable undertaking, with a quite well-secured income. One question, of course, was as to how Mr. Anderson's salary and bonus should be dealt with. In 1908, his bonus under the terms of the agreement was £79; in 1909, £121; and in 1910, £156—in addition to his salary. It looked to him as if the Council had got to take Mr. Anderson over; and if they did, it would perhaps be more equitable that his bonus should be deducted before the Company were compensated. If, on the other hand, he was not taken over, his bonus should not be deducted before the compensation was paid. He was going to put it that probably the right thing to do was to deduct the bonus. But Mr. Anderson could not go on for ever; and therefore, while giving credit for the amount Mr. Anderson received under his agreement as bonus, the Company asked the tribunal to allow them the saving which would accrue if, and when, Mr. Anderson came to the end of his life. The gas made increased under Mr. Anderson's management from about 3,600,000 cubic feet in 1902 to 6,476,000 cubic feet in 1908. During the last few years, the make had decreased slightly. The unaccounted-for gas was 20 per cent. in 1902; but by 1910 it had been reduced to 10·8 per cent. With regard to the maintainable profit, there were two ways of looking at this. He would call Mr. Henry Woodall and Mr. Frank Jones, who had looked at the matter from slightly different points of view. Mr. Jones treated it as one undertaking, and had taken the profits arising from the sale of fittings and coal as part and parcel of the concern, and had arrived at what he thought was a fair maintainable profit on the whole undertaking, and multiplied it by so many years' purchase. Mr. Henry Woodall, on the other hand, had taken the profit from the sale of fittings and coal as being in a different category, and had eliminated them to start with. He had found the maintainable profit from the gas business proper, multiplied this by so many years' purchase, and then multiplied the profits on fittings and coal by a lesser number of years, so arriving at a slightly different conclusion. Mr. Jones took the profit for 1910 as £492 (deducting Mr. Anderson's bonus of £156), and multiplied this by 22 years, giving £10,824. Then for the surplus works he claimed £1000. Beyond this, Mr. Cash would state that the allowance which should be fairly made in respect of Mr. Anderson, which he had already referred to, would be about another £1000. This left only to be dealt with such a sum as it might be thought proper to allow for covering the compulsory purchase, disturbance, cost of re-investment, and so on. Mr. Henry Woodall took the figure of £492, and deducted the coal and fittings profits for 1910, which left £407. This he multiplied by 25 years' purchase, arriving at £10,175. He then took the £85 for coal and fittings profits, and multiplied it by five years, which gave £428—making the total for the undertaking £10,603. To this he added £1000 for surplus works; and there would also be the matter of the allowance to Mr. Anderson to deal with, and the consideration for compulsory purchase.

THE COMPANY'S WITNESSES.

Mr. *William Cash*, examined by Mr. SZLUMPER, said he had examined the books of the Company, in conjunction with Mr. Spencer, who was acting for the Council. The tables put in had been agreed with Mr. Spencer, subject to certain reservations set out upon them. There were no detailed records that would be useful for the arbitration up to December, 1901. In fact, down to that date he did not think the Company had made a profit. The Company passed under the management of Mr. Anderson in the early part of 1902; and his tables were for the most part based upon matters subsequent to this date. The profit to net revenue account was £490 in 1908, £545 in 1909, and £648 in 1910. In 1902 and 1903 no dividend was paid upon the ordinary shares. In 1904, 2½ per cent. dividend was paid; and then the dividend was brought up to 10 per cent., at which it remained during 1910. The preference capital came into existence in 1905; and the 6 per cent. dividend on it had been regularly paid. The gas made per ton in 1902 was 8212 cubic feet; while in 1910 it was 10,156 feet. In the former year the price of gas for ordinary lighting purposes was 6s. 3d. per 1000 cubic feet; and this figure had since come down to 5s. 3d., with a charge for cooking of 4s. 2d. per 1000 cubic feet. There had also been some alterations in regard to the supply of gas for engines. Public lamps were charged for at the rate of 35s. each for the season. There were 77 public lamps. With regard to the arrangement with Mr. Anderson, if the Umpire felt that this was an appointment for life, then at the end of Mr. Anderson's life there would be a saving of the difference between the amount paid him and that at which a suitable manager could be appointed. The arrangement in this case was, of course, an exceptional one. He took Mr. Anderson's expectation of life at 23 years; and the present value of an annuity of £100 per annum deferred for 23 years on the 3½ per cent. table was £1295, and on the 3¾ per cent. table £1143 10s.

Cross-examined by Mr. VESEY KNOX, witness said 6 per cent. was not an unreasonable rate of interest to pay on preference shares in a Company like this. As to the ordinary shares, some of the amounts paid on these were stated to be on account of back-dividends for previous years, when smaller distributions were made. During the past three years, the Company apparently did not earn the dividends which were shown as having been declared and paid. In the earlier years they earned profits which they did not think it wise then to distribute. The number of ordinary consumers was 121, and of prepayment 253. The revenue from the prepayment consumers averaged just over £2 each—representing a consumption of 8300 cubic feet. This was not a very small average. There was nothing in the Memorandum of Association about selling coal; but he would not have thought the sale of coal was *ultra vires*, having regard to the last clause. For the five years to 1906, the profits showed an annual increase. In 1907, there was some falling off; but there was a reduction in price in that and the preceding year.

Mr. *Robert Bruce Anderson*, examined by Mr. HONORATUS LLOYD, said he was Secretary, Engineer, and General Manager of the Company under an agreement. For many years he had managed numerous gas undertakings in Ireland. His father had a lease of the Mallow works which expired in 1885. That was a time when oil became very cheap; and these little undertakings were very difficult to work profitably. The Company could not get anyone else to take the works over; and his father carried them on, on account of the Company, until 1888. Then liquidation followed; and the New Mallow Gas Company, Limited, was registered in 1889. During the time after his father's lease expired and when he was working the undertaking for the Company, the Company did not provide any money at all. When the new Company was formed, they simply carried on the works as they found them. They spent no money on improvements. The new Company paid £1250 for the whole concern. The arrangement that had been referred to was made with him in the autumn of 1901; and on Jan. 1, 1902, he took possession of the works. He undertook the general management for a salary of £25 a year, *plus* a moiety of all profits earned in excess of what was necessary to pay 5 per cent. on the ordinary shares. In the early years, he had his £25, and nothing else; but he gradually pulled things together, and practically rebuilt the works. Half the cost of this was charged to capital, and the other half to revenue. This, he thought, was generous on his part towards the shareholders. The business was pushed on up-to-date commercial lines. The relations between the Company and the District Council had not been satisfactory. The Council had made a charge of 3s. for every short opening the Company made in the roads, and

6s. for the longer ones, where the services had to be laid right across the road. These charges had averaged out to about 12 per cent. of the total public lighting accounts. Then from time to time resolutions had been passed prohibiting the Company opening the streets. This had prevented the Company from expanding. They could have secured a lot of business if they had had a free hand. In the autumn of 1909, the Company proposed to apply for statutory powers; and the Council went to Parliament to secure authority to compulsorily acquire the undertaking. The Company dropped their Bill. There had been no substantial complaints with regard to the gas supply. The sale of gas was now about five times as much as when he took over the management. The works had been thoroughly well maintained, and were generally in excess of the present requirements. In fact, with a comparatively small expenditure they would be able to deal with nearly double the existing output. The aggregate rent for the three plots of leasehold land on which the works stood was £35. The leases had about seventy years to run; and the sinking fund was agreed. Quite a good business was done in fittings and coal. His salary and bonus last year came to £180; but now that the concern was in a good condition, the Company could get an engineer to do the work he had been doing for £75 a year. As a large shareholder, he was willing that, inasmuch as the agreement with him stood, his full salary and bonus should be deducted from the maintainable profit before it was capitalized—provided that a suitable allowance was made in respect to savings to the shareholders in the event of his death. In the event of his being taken over under the contract section of the Act, the Company were entitled to the reversion which they would get (as had been calculated) 23 years hence in the event of his death.

Cross-examined by Mr. VESEY KNOX: He took shares when the Directors were unable to get people to take them on the same terms; and he had taken quantities as wanted all through the period of the agreement. The public lighting was charged at so much per lamp; and he had never worked the figures out so as to be able to say whether the rate came to 6s. 4d. per 1000 cubic feet. The 35s. per lamp was quite a reasonable charge, considering the great risk the Company ran (for they had nothing to do with the lighting and extinguishing of the lamps) of having more gas consumed than the hours calculated for would work out to.

Mr. VESEY KNOX: You say that if the Company had gone on this 6s. 4d. per 1000 cubic feet was a maintainable price?

Witness: The 35s. Yes, under the circumstances.

Do you know any other case where the public lighting is charged at rather over 1s. per 1000 cubic feet more than the ordinary, and something like 2s. more than prepayment supplies?—I do not have much experience of other local authorities where they do the lighting themselves. It is customary for the gas company to do the lighting; and then the circumstances are entirely different.

Cross-examination continued: Mallow had not been an increasing place. The population was 4439 in 1881, and 4452 in 1911. He did not, however, remember a single bankruptcy in the place. It was chiefly a market town. The rateable value, taking it all round, might come out to less than £10 per house, but it was above the average of Irish towns.

Second Day.

Mr. *Anderson*, further cross-examined by Mr. VESEY KNOX, said the charges of 3s. and 6s. made by the Council for openings in the roads were not for restoring the surfaces, but were simply a tax levied on the Company, who always themselves left the roads in good order and reinstated them in a satisfactory manner. The Council had complained of the gas supply; but the troubles were simply due to local defects, which were easily remedied. Resolutions were passed by the Council prohibiting the opening of the roads generally; but, as a matter of fact, he did not think the Company had ever been prevented from connecting-up a single would-be consumer. This policy had, however, prevented the Company from extending their business, because there would be a lot of consumers they could not take on, as they did not want to have any friction with the Council. In these Irish towns, people did not run after companies for gas; the companies had to go to them. It was possible that the first resolution of the Council prohibiting the breaking-up of the streets was passed when the Company were trying to raise the charge for public lighting. On a reduction being made in the price of gas, this was rescinded; but other similar resolutions were passed subsequently. It might be that the period during which the Company were prevented from opening the streets did not exceed six weeks in all; but the position was quite insecure. Asked why they charged the slot consumers less than the ordinary ones, he said it was a case of doing so or not having their business at all. He had never disturbed the slot-meter price; but he had repeatedly lowered the charge to the ordinary consumers. He secured coal for all the companies with whom he was connected by one transaction; and this might give some advantage which one of the undertakings acting separately would not have.

Re-examined by Mr. HONORATUS LLOYD, witness said there had been no substantial complaints by the Council as to the condition in which the Company left the streets after laying mains. Nobody to his knowledge or with his authority had arranged any terms in consideration of the local authority making good roads that the Company left in an improper state. With the exception of the improvements that had been made in the earlier years, all renewals, whether of works, mains, meters, or stoves, had been charged to revenue.

Mr. *Frank Jones*, examined by Mr. SZLUMPER, said he had visited the works and prepared some figures which were based on the agreed tables of Mr. Cash and Mr. Spencer. He considered it a well-managed Company; and the works were in very good order. As to the capacity of the plant, the gas storage and purifiers showed a considerable surplus over present requirements. He put the value of the surplus plant as follows: Holders, £630; purifiers, £180; and sundry small items, £190—making £1000 in all. The works had been exceedingly well maintained.

The ARBITRATOR: I have seen them. I may say that when Mr. Newbigging was there, he intimated to us that he was not going to make any allegation against the maintenance of the works.

Mr. NEWBIGGING: Not as to the maintenance of the works; only on the question of the efficiency of the plant.

Mr. VESEY KNOX: Our position is that there is a surplus in some items and a deficiency in others; but we are not going to make either a claim or an allowance in regard to anything.

Examination continued: The capital expended—£6222—was fully represented by the value of the works. He had made a structural valuation; and it came to slightly over £6000, taking very moderate prices. The capital per million on the sale of gas last year was £1200, which was quite a moderate figure for a Company of this size. Except the last year or two, the business had been a progressive one; and he would consider it a good going concern. The unaccounted-for gas at 10 per cent. was rather high for this district, but nothing out of the way. He took the year 1910 as the basis of his valuation, and merely deducted the amount of the bonus paid to Mr. Anderson. That was to say, from £648 he deducted the bonus of £156, which gave him £492 with which to start. This he multiplied by 22 years' purchase, which gave him £10,824. For the surplus works he added £1000—making £11,824. He had put on nothing for compulsory purchase, to cover the cost of re-investment, and so on, because he did not regard this as an engineering question. Neither had he included any amount for the reversionary interest with regard to Mr. Anderson.

In cross-examination, Mr. VESEY KNOX questioned witness at length as to his evidence in the Lisburn case; but Mr. Jones maintained that each case must be taken on its merits. In this instance, he said, he had taken as the subject of his multiplier the gross figure, without any deduction for depreciation. There had been a very large expenditure by the Company, which, in his opinion, was ample to cover renewals, repairs, and depreciation. A sum of 8d. per 1000 cubic feet was enough, especially looking to the fact that the previous year they had spent 11d., and the year before that 15d. The Company had a large, but not an extraordinary, proportion of prepayment meters and stoves. He did not consider Mr. Anderson had been paid any too much for what he had done; and he did not think they would get anyone to go over there and do what he did under £150 a year. He had multiplied the coal and fittings profits by 22 years as well. The fittings department was as much a part of an undertaking as making sulphate of ammonia or the bye-products of tar. Many companies were making a profit out of fittings, though the business was usually carried on as nearly as possible at cost. As to the sale of coal, part of the profit of the undertaking was earned from this business; and he did not see why Mr. Anderson and his Company should be turned out of Mallow and not be compensated.

Mr. VESEY KNOX: You know if he had got statutory powers he would not have been allowed to sell coal?

Witness: I believe not to-day; but I think some companies do it.

The Lord Chairman always strikes it out now?—Yes.

Cross-examination continued: The capital per million cubic feet of gas sold, if the undertaking were purchased upon his valuation of £11,824, would be just under £2300.

Re-examined by Mr. HONORATUS LLOYD: He thought £2300 per million cubic feet sold was a price which other authorities had had to give for gas undertakings.

The ARBITRATOR: If you take the case of an ironmonger supplying fittings, you would not give 22 years' purchase of the profits of this ironmonger's business to purchase the goodwill, would you?

Witness: No, I think not.

Nor would you give 22 years' purchase of the profits of a coal merchant's business?—Not by itself.

Mr. *Cash*, re-called, and examined by Mr. HONORATUS LLOYD, said he had tabulated the dividends according to the reports. The Company paid their dividends in a peculiar way—so much on account of each year and so much on account of preceding years. These back dividends were calculated on the capital standing in each of the preceding years. That was to say, they did not pay 10 per cent., for instance, in the year 1910 on the full capital of 1910. They paid 7 per cent. on the capital of 1910, and ½ per cent. in respect of the capital outstanding from 1904 to 1909.

Mr. VESEY KNOX (in cross-examination): I am not quite sure that I understand this point. Am I right that any shares of the last issue—that is to say, the ones issued in 1909—have received only 7 per cent.?

Witness: That is right. It is the total they have received.

And to pay 10 per cent. on the capital which had been issued in the year 1910 would have required a larger sum than that which was needed to pay 7 per cent. on the capital issued in that year, *plus* these back-dividends?—Yes.

So that they have never even declared a dividend equal to 10 per cent.?—In that sense, no.

It comes to this—that the Company have never even declared 10 per cent., or the equivalent of 10 per cent.?—Not on present capital.

Mr. *Henry Woodall*, in answer to Mr. HONORATUS LLOYD, said he had visited the works and made a structural valuation for the purpose of satisfying himself that the capital of the Company, as shown in the books, was represented by works. His valuation was £6498. The works were in excellent condition; and, compared with other similar companies, the prices charged for gas were quite reasonable. There was considerable surplus capacity in the plant; and this he had valued at £1000, as Mr. Jones had done. There had been a substantial increase in business up to 1910, in which year there was a slight decrease of 1·2 per cent. After the passing of the Act, the Company gave an undertaking not to spend any more capital; so that new consumers could not be put on to take the place of any dropping off. He had looked at the agreed accounts with a view to seeing what, in fact, had been spent per 1000 cubic feet on maintenance, repairs, and renewals. He found that there had been spent in the account year 7·85d. per 1000 cubic feet, which was a very much larger figure than he usually took for works of this size. It was ample for everything that was required in the way of repairs and depreciation. The undertaking had been very well managed; but he thought now they could get an engineer in Ireland to look after it for fifty guineas a year. As to the fittings and coal sales, he did not think these could be treated in the same way as the gas business; and he had therefore dealt with them separately. He had taken the profit of £648 from the agreed accounts, and deducted the profits on fittings and coal and Mr. Anderson's fee and allowances. This left a sum of £407, which he regarded as maintainable profit which could be largely increased in future. He applied 25 years' purchase, which he thought was the lowest figure he

had ever taken. Multiplying the £407 by 25, he arrived at the figure of £10,175; and to this he added five years' purchase of the profits on fittings and coal sales, £428—making £10,603. Then he suggested 10 per cent. as an allowance for disturbance and compulsory purchase, and £1000 for surplus works—bringing the total to £12,663, without reference to any future saving in respect of Mr. Anderson.

Cross-examined by Mr. VESEY KNOX: There were companies which spent a good deal more than 8d. per 1000 cubic feet on repairs and renewals. He had taken five years on the fittings and coal sales; while perhaps three years was the more usual figure. He had, however, gone into the matter with Mr. Anderson; and it seemed that these two businesses were rather better secured than usual. There was a great deal to be said for selling fittings at cost price, and giving satisfaction to the consumer. But this was not the method adopted here; and it was not the method adopted by a great number of companies. He had never put so low a value on an undertaking before; but he understood the value of gas-works in Ireland was not so great as in England, and he had taken 25 years.

Mr. VESEY KNOX: Can you point me to any undertaking, statutory or non-statutory, anywhere in the civilized world which is valued by the public on this basis?

Witness: No.

So that you are putting the undertaking in Mallow on a higher basis than any other gas undertaking in the world is put by the ordinary investor?—I am not valuing in that way at all. I consider they are forced to sell this concern, and ought to have a big price for it.

Is not that allowed for in the 10 per cent.?—No. As you say, I have put in the 10 per cent.; but this is a figure I leave entirely, as I must, to the Arbitrator

Your valuation is not what you think the undertaking is worth, but what you think Mr. Anderson ought to be given for it?—Undoubtedly. I do not for a moment suggest that any undertaking of this size is worth more than a 5 per cent. basis. You can get any amount of undertakings which are quite as secure—more secure, I think—to pay you 5 per cent.

This completed the case for the Company.

THE KIRKCALDY GAS ARBITRATION AWARD.

A General Meeting of the shareholders of the Kirkcaldy Gaslight Company, Limited, was held in the Town Hall, Kirkcaldy, on Friday last for the purpose of considering the accounts of the Auditor—Mr. W. L. Macindoe. He said there should be two reports—one dealing with the period when the Directors were conducting the concern on behalf of the Corporation, from May 31, 1910, to May 31, 1911; and the second dealing with the Liquidator's intromissions. The price per the award was £137,160, and the interest paid to the Corporation was £4804—together £141,964. From this there had to be deducted some adjustments on the balance-sheet of May, 1910, which came to £51; so that the net price paid by the Corporation was £141,913. To this had to be added the amount of interest which had accrued on various deposit receipts in the course of the liquidation proceedings, bringing the total sum to be dealt with to £141,952. From this there fell to be deducted, in the first place, the expenses of the arbitration. These amounted together to £7161. The sum recovered from the Corporation was £3427; so that the net charge against the Company was £3734. Before passing from this statement of expenses, he should like to mention that he was able to get the following abatements made on the skilled witnesses' fees: Mr. Stevenson, £69; Mr. Woodall, £39; Mr. MacPherson, £450; Mr. O'Connor, £63; Mr. Marwick, £25—total, £750. The next deduction was from Mr. Woodall, for preliminary work, £60. He settled with Mr. MacPherson for a combined sum in full for his claims, pension, and everything else—£2561. The claim was divided between commutation and witness fee. The capital return was a first dividend of £9, which took £117,603; and a second dividend of 15s. 9d., which came to £19,290. The total return was £127,893. He had put in a statement of the total deductions and the total price; and it showed a difference of £1009, which he proposed to charge at £1000. Replying to questions, Mr. Macindoe said that the accounts had not been taxed. He did not think that any practical good would have resulted. He did not consider there was any doubt but that the Directors of the Company, if they had been approached before the arbitration, would, had they taken his advice, have recommended the shareholders to take a sum much nearer £9 than £10 per share. The £1000 was the fee that he had fixed. After a little further discussion, a small Committee was appointed to examine the accounts, and report to a future meeting.

PRICE OF GAS AT CHATHAM AND ROCHESTER.

Protest by the Medway District Chamber of Trade.

In the Minor Hall, Chatham, last Tuesday, a meeting, convened by the Medway District Chamber of Trade, was held for the purpose of protesting against the price charged for gas by the Rochester, Chatham, and Gillingham Gas Company. Mr. W. Paine, the Chairman of the Chamber, presided; and there was only a small attendance.

In opening the proceedings, the Chairman remarked that from time to time the Chamber had had interviews with the Directors of the Gas Company on the subject of the price of gas; and they had always been treated most courteously by these gentlemen, who had given them plenty of promises. But while the Directors had been very prolific in these, nothing had been done in the way of reduction. The Chamber had convened the meeting in order that any consumers might join in the protest. They considered they had a good case for a reduction. Having compared the prices charged for gas and the number of consumers in various towns in Kent, the speaker said that in Chatham they had to face a monopoly, and he had been told that any protest they made would be laughed at. He had applied a remedy of his own, by not using more gas than he possibly could. At his residence, the maximum consumption was at one time £20 per annum, whereas now it did not exceed £5.

Particulars of the correspondence which had taken place between the Chamber and the Gas Company were submitted by Mr. E. Bates, the Hon. Secretary. It commenced early in 1909, when a deputation waited upon the Directors, and a reply was received that the Company hoped the time was not far distant when a reduction in price would be made. In reply to a further communication, the Directors promised to make a reduction from Jan. 1, 1910. But this promise had not been fulfilled, though more appeals had been made. The strike and the increase in the price of coal had been brought forward as difficulties in the way of a reduction.

Mr. F. A. Clements moved: "That this meeting of traders (and consumers of gas) of Rochester, Chatham, Strood, and Gillingham protests against the continued high price charged for gas by the local Company, and requests the Directors to carry out their promises by making a reduction forthwith." He said he thought that, as consumers of gas, they would all agree that the statement that the price was high was no exaggeration, especially after the comparisons given by the Chairman of the charges in other towns, some of which did not have their works so conveniently situated beside a river as those at Rochester. The speaker quoted the prices charged in several other places, and concluded by concurring with the Chairman in his remark that the Company ought to fulfil their promises. Mr. W. W. T. Barnett seconded the motion, in the interests of the Co-operative Society. Mr. A. W. Ireland, a member of the Corporation, expressed surprise at the small attendance, and said he considered the consumers should have come to the meeting in thousands. It was a pity that not more interest was taken in the matter.

After some further remarks, the motion was carried unanimously; and thanks were accorded to the Chairman for presiding.

SOUTHPORT CORPORATION AND VERTICAL RETORTS.

Councillor Objects to Roving Deputations.

The presentation of the minutes of the Gas Committee of the Southport Corporation at the monthly meeting of the Town Council last Tuesday gave rise to an unexpected discussion. It was opened by Mr. Snow, who said the minutes were not a true record of what occurred at various meetings. He called attention to the following resolution passed by the Council on Oct. 13, 1908: "Resolved, that the various Committees of this Council be instructed that they have no authority to incur expenditure by sending deputations away from the borough until the resolution to send a deputation has in each case been first approved by this Council, or where the Mayor consents." He said there was no resolution on the minutes that a deputation was authorized to go racing all over the country and spending the Council's money; therefore the minutes were not a true record of the Committee's proceedings, and he objected to them. He presumed that the Committee had not received the sanction of the Mayor; and this rendered the action of the Chairman and Vice-Chairman absolutely irregular. It was on this account that he protested.

The Chairman of the Committee (Mr. Trounson) said no application was made for the sanction of the Mayor. He was fairly conversant with the Standing Orders of the Council, but he was in entire ignorance of such a resolution as the one read by Mr. Snow. Had he had any notion of it, Mr. Snow would not have had any ground for his remarks. He (Mr. Trounson) could give the Council all the details if they wished; and the matter could be entered on the minutes if it was delayed two or three weeks, or, by special instruction of the Council, it could be entered there and then.

Mr. Snow moved, as an amendment, that the minutes be referred back to the Committee, and come up for confirmation at the next meeting. Alderman Brighthouse suggested, however, that as the Chairman of the Committee had agreed to insert on the minutes the resolution which had been omitted, the amendment should be withdrawn, and the way left clear for dealing with the new minute along with the others.

Mr. Trounson then stated that he found he had in his possession some papers which were brought up to date. The resolution was that the Committee should send the Chairman, Vice-Chairman, and Gas Engineer (Mr. John Bond) to the various places where vertical retort systems had been installed. He would now move that the minutes be approved, with the addition of this minute. Proceeding, he said the question of vertical retorts was a modern one, and had been before the Committee since March, 1908; and it was a question whether they should adopt this system instead of horizontal retorts. Some months ago, the Committee asked the Gas Engineer to prepare a report on the question. This was done and presented to the Committee; but he said he was not able to give a detailed report without investigation where the vertical retorts were being employed. They appointed a deputation to make the investigation. It was first suggested to send three members, along with the Gas Engineer. But the Committee thought, after discussion, that two would be quite sufficient; the Vice-Chairman and he were to go. There were five different systems of vertical retorts in the country, and there were four which the Gas Engineer preferred to see. But of the two they had inspected they had obtained such information, through being on the spot, that he ventured to say would compensate the Committee already to the extent of some £250; so that they had received more than value for the expenses entailed. The proper time to discuss the matter would be when the plans and report from the Gas Engineer were before them.

The motion for the adoption of the minutes having been seconded, Mr. Snow said he had not had an opportunity of speaking upon the new minute. He desired to raise the whole question, so as to prevent irresponsible members of the Council racing all over the country spending the ratepayers' money. However, after listening to the explanation given by the Chairman of the Committee, he would withdraw his amendment; but the matter was certainly irregular.

The minutes were then passed.

THE RETIREMENT OF MR. WILKINSON FROM HALIFAX.

At the last monthly meeting of the Halifax Town Council, the minutes submitted by the Gas Committee contained the announcements that the Gas Engineer (Mr. John Wilkinson) had been appointed Gas Engineer and General Manager of the Nottingham Corporation gas undertaking; that the Committee had accepted his resignation with regret; and that they had conveyed to him their best wishes for his success in his new appointment. They had resolved to advertise for a successor at the commencing salary of £500 per annum, and had appointed the Chairman, Vice-Chairman, and three members to go through the applications received, and reduce them to four, who were to appear before the full Committee.

The adoption of the minutes having been moved and seconded,

Mr. Sowood (the Vice-Chairman of the Committee), in supporting the motion, said he was expressing the feeling of the whole Council when he said that they all very much regretted they were losing Mr. Wilkinson's services. During the eight-and-a-half years that he had been with them, he had fulfilled his duties in a way that had been satisfactory, not only to the Council, but to the ratepayers in general. When he took charge of the works, they were not in the rosy condition that the Council wished them to be; but to-day, thanks to the hard work Mr. Wilkinson had put into them, they were in a flourishing condition. As a buyer he could not be excelled, and the borough had received considerable advantage by the smart way in which he had watched the markets; as a seller, he had obtained the best price for the residuals he had had to dispose of; and as a gas maker, he had given satisfaction. They could not part with such a man without feeling his loss. Not only had he dealt fairly with the Corporation, but he had won the esteem of the workmen under him by doing the same with them from the wage point of view. A man who had shown himself to be an all-round engineer and an all-round business man, and who had dealt well with the employees, had every credit due to him; and he left Halifax with the feeling of sympathy and goodwill from the Labour section of the Council. He (Mr. Sowood) hoped Mr. Wilkinson would be as successful at Nottingham as he had been at Halifax.

Mr. Smithson remarked that it was a misfortune for Halifax that they were losing Mr. Wilkinson. He was, as Mr. Sowood had said, good in his expert knowledge as a gas manufacturer, and extremely good as a business man, both in placing contracts and in the sale of residuals. Beyond either of these points, they had appreciated him because he was a man in whom the whole of the Gas Committee had had the fullest confidence. He was a man of the strictest integrity; and they could leave matters of considerable delicacy almost entirely in his hands. They would be extremely fortunate if they got as good a man in his place.

Alderman Brearley said the members would endorse everything that had been said in respect to their Engineer's ability and his many qualifications. The only point he wished to refer to was the question of the salary proposed for Mr. Wilkinson's successor; and it was a moot point, he thought, whether £500 was a sufficiently attractive figure. He ventured to suggest it was desirable to offer £600 if they were to get a man anything like the equal of Mr. Wilkinson.

Alderman Smith supported the suggestion that the salary should be £600.

Mr. Redman said the Gas Committee had had the matter under careful consideration, and they proposed to pay £500 because they were confident they could get a suitable man for this salary. The difficulties connected with the gas-works were practically gone, and there seemed little prospect of any great expenditure there, as no new schemes were in contemplation. With what had been said in praise of Mr. Wilkinson, he was in hearty accord. He had only been associated with him for nine months; but from the first he found him a remarkable character. He was absolutely open with his Committee; any member could get from him the best information it was possible to give, and he had exercised remarkable tact, not only in his purchases and sales, but in his management of the workmen. There were a good many ways of giving an instruction; and Mr. Wilkinson seemed to have the very best way. Every member of the Committee who had come in contact with him appreciated his services in Halifax; and they offered him every good wish for his further success.

The minutes were then approved, with £500 as the commencing salary, as proposed by the Committee.

Reviewing the work of the Council at the meeting referred to, a writer in the "Halifax Courier" made the following appreciative remarks on the subject of the retirement of the Gas Engineer: "Mr. Wilkinson has retired, having secured a more profitable appointment. He leaves Halifax carrying with him the respect and best wishes of all who knew him. It is seldom an official receives such unanimous and genuine praise. He was described as a remarkable character for the curious and yet sufficient reason 'that he had nothing to hide.' He was a genuine man, and everybody had confidence in his integrity. . . . He carries with him the good wishes of the Labour party, because he has been a gentleman—not a 'tailor-made' man, garnished with cuffs and collar, but a real man, having the proper spirit in him."

The Improved Public Lighting of the City.—Referring to this matter last Saturday, the "City Press" said: "The new lighting scheme of the City will be in active being in the course of a very short while. All the preliminaries have been disposed of, and now, with the two Companies concerned, it is a case of 'full-steam ahead.' Meanwhile, the citizens are enjoying the boon in anticipation. Fancy obtaining almost double the light at a reduced cost of £7000 a year. It seems almost too good to be true. Mr. Gunton, the Chairman of the Streets Committee, deserves to be designated the Civic Santa Claus—or, better still, the Twentieth Century Aladdin, in giving us new lamps for old."

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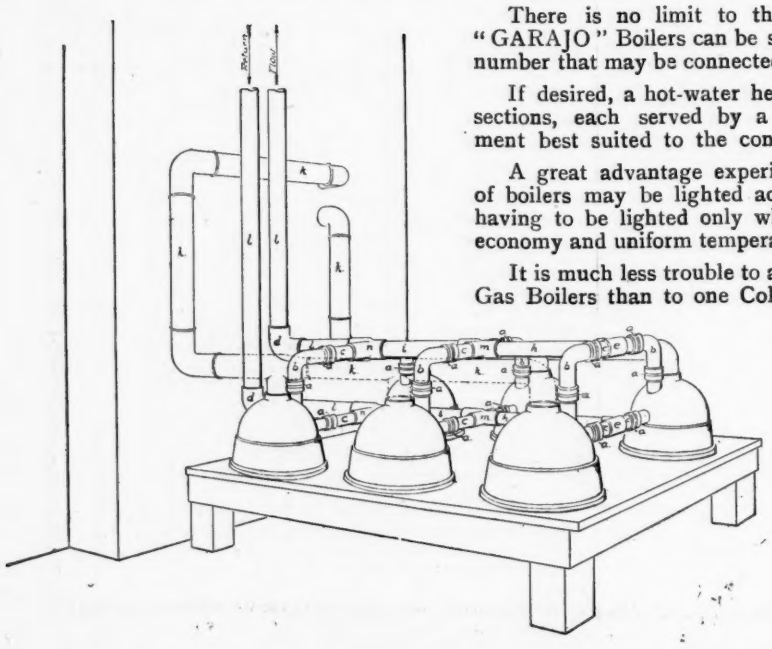

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HARROW GAS COMPANY AND PROFIT SHARING.

Explanation of the Scheme.

There was a large and enthusiastic gathering of the employees of the Harrow Gas Company in the Mission Room, Roxeth, on Monday evening last week, in response to an invitation of the Chairman (Mr. A. H. Baynes, J.P.), to hear an explanation of the profit-sharing scheme which, as already stated in the "JOURNAL," the Directors have decided to introduce. The chair was occupied by Mr. Baynes, who, after a few preliminary remarks, asked the Company's Engineer and Secretary (Mr. James L. Chapman, J.P.) to explain the scheme.

Mr. Chapman, who was cordially received, said the idea of the Directors was that each one of the employees should become a shareholder in the Company, the well-being of which was the purpose of the profit-sharing scheme. The bonus would be calculated on the ordinary salaries and wages, exclusive of overtime and piecework. If the price of gas was at or above 4s. per 1000 cubic feet, there would be no bonus; but if it was 3s. 11d. the bonus would be ½ per cent. There would be an additional ½ per cent. for each drop of 1d.; so that with gas at 2s. 6d. the bonus would be 9 per cent. To give the scheme a good "send-off," the Directors had decided to date the bonus from the 1st of January last. Thus on the 31st inst. a whole year's bonus would be credited to each man entering into the necessary agreement. This bound the Company to provide work for twelve months; and, on the other hand, the employee undertook to obey orders. There was a proviso to enable any man who had an opportunity of improving his position to leave on giving a week's notice, with the consent of the Manager, which would always be granted if the man could be spared without injury to the Company. In conclusion, Mr. Chapman urged the men to do their best for the consumers. He assured them that he personally took a deep interest in everyone on the works, whether foreman or office lad; and he would always do what he could for them if they came to him.

Mr. Rowell, the Chief Inspector, on behalf of the men, expressed their approval of the scheme, and said they would be pleased to do their best for everybody concerned. Mr. Cady, the Chief Collector, speaking for the staff, thanked the Chairman and Mr. Chapman for arranging the meeting and explaining the scheme. Mr. Chambers, the Assistant-Manager, referred to the long service of some of the men, and said he was sure all on the works would do their level-best for the Company. Having given figures to show the growth of the undertaking, he expressed the hope that the men would continue to work with zeal, and that ultimately the price of gas might be brought down to 2s. 6d. per 1000 cubic feet, so that by the profit-sharing scheme they would get 9 per cent. bonus. He concluded by saying how they valued Mr. Chapman, who had a heart for everyone.

The Chairman said he was delighted to be present; and the meeting had been a great inspiration to him. He believed that in working out the profit-sharing scheme both the Company and the employees would be relieved of a great deal of anxiety. With regard to Mr. Chapman, he had not heard a word too much in praise of him. He felt that in him they had a gentleman who took a real interest in the Company. He had rendered splendid service; and while they were indebted to all the employees for the way in which they had helped him, they felt they were specially indebted to Mr. Chapman, who had thrown such an amount of energy into his work, and had placed the Company among the foremost gas undertakings around London.

Mr. Chapman, in thanking the speakers for their kind remarks, said that, however great his desire might be for the prosperity of the undertaking, he could say truly that he had never put the Company before the workmen. They were all fellow-workers; and he thanked them all for the help they had been to him, and for accepting the offer made to them, which he knew would be for their mutual benefit.

MR. THOMAS BERRIDGE ON THE POSITION OF LABOUR.

A Plea for Profit-Sharing.

On the occasion of the thirty-ninth half-yearly distribution of books in connection with the Leamington "P.S.A." Brotherhood, which took place on the afternoon of the 10th inst., Mr. Thomas Berridge, J.P., the Engineer, Manager, and Secretary of the Leamington Gas Company and a member of the Corporation, who made the presentations, delivered an address, in the course of which he offered the following observations on the position of the wage-earner. They possess additional interest when read in connection with the gathering at the South Metropolitan Gas-Works on the preceding Friday, as recorded in the "JOURNAL" last week.

You often hear it said that people are being educated above their station, and that education is responsible for the unrest of which we hear so much nowadays. To a certain extent this is true; and, while detesting strikes, I am not one of those who believe that unrest is always, and under all circumstances, wholly a bad thing. There is the rest of stagnation and decay, as well as the rest of true peace and contentment; and a very despicable and deadly thing it is. There is the unrest of noble discontent, as well as that of mere unreasoning envy and class prejudice; and, unless I altogether misread the signs of the times, a deal of the modern unrest is of the first-named class. Frankly, I do not consider that the present position of the average wage-earner is such as should satisfy any thinking and self-respecting man. The country is quite rich enough to give to all its workers a fair living wage; and it is to the real interest of the nation as a whole that such a wage should be paid. The worker, in very many cases, naturally and properly feels that the faculties he employs ought not only to earn

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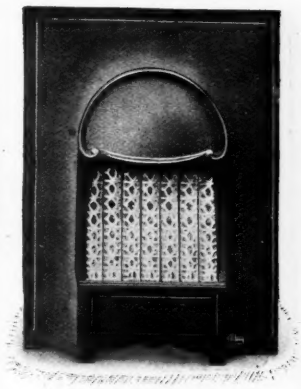

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him a bare substance, but should entitle him to a share of the profit which his employer makes, and which, in part at least, is created by his labour. This is a legitimate desire; and I believe that it would be possible to satisfy it by so organizing practically all kinds of work that the man on a weekly wage would take his share of the profit, and also stand his fair share of the loss. If this were done, I am convinced that it would go a long way towards solving those problems in the labour world which are giving so much concern to Governments and capitalists at the present time; and, further, I do not think it would cost the employer a single penny.

IMPROVEMENTS AT THE DEVONPORT GAS-WORKS.

In moving the adoption of the minutes of the Gas Committee at the meeting of the Devonport Town Council on Thursday last, Alderman Tozer stated that improvements which the Council sanctioned in March, 1910, had recently been completed. The amount of the loan sanctioned was £6000; and the results so far achieved more than justified the expenditure. The first and most important result was a substantial increase in the production of gas per ton of coal carbonized. There had been a greater demand for gas this year than in any former similar period. In 1910, there was an increase of 13 million cubic feet in the consumption; and for the first half of the present year, there was a further increase of 11 millions. There was reason to believe that in the second half the results would be not less satisfactory. Though the reduction in the price of gas last year had considerably lessened the net profit, he thought that at the end of the financial year it would be possible to make a still further concession. The works were second to none in practical utility; and the gas produced was in excess of the normal standard in both candle power and heating properties. Owing to the increase in the demand for gas, the coal for which they had contracted would not last until June next, when the time would come for entering into new contracts; and the Committee purposed making experimental purchases of cargoes of coal to supply the deficiency, which would amount to about 5000 tons. It was proposed to appoint a man to take charge of the water-gas plant, the results from which had not been found altogether satisfactory. A competent man was temporarily engaged; and the two sets were overhauled—the effect being an increase of from 8 to 10 candles in the illuminating power, while the consumption of oil had decreased. The appointment of a skilled operator would mean that they would get better results at less cost. The recommendation of the Committee that a man should be engaged to take charge of the water-gas plant was agreed to.

Wigton Rural Water Supplies.—The Wigton Rural District Council last Tuesday, after a prolonged discussion, adopted a scheme for supplying nine parishes in their area with water, to be purchased from the Aspatria, Silloth, and District Joint Water Board.

INCREASED STORAGE FOR ILFRACOMBE GAS COMPANY.

Inauguration of a Spiral-Guided Gasholder.

A new spiral-guided gasholder which has been erected at the Ilfracombe Gas-Works was formally inaugurated last Thursday. It has been erected by Messrs. R. & J. Dempster, of Manchester, who some six years ago built the present works for the Gas Company. The holder, which is 80 ft. by 20 ft., has eight guide-rollers, and stands in a steel tank of which the dimensions are 84 ft. by 20 ft. 6 in. The holder is provided with a collapsible ladder, which automatically falls over as the holder goes down. With a view to prevent the discolouring of the plates by water falling off the crown, the holder is provided with an arrangement by which the water will be conveyed by a channel into the guide-bars, and then direct into the tank. The foundations of the holder were constructed by Mr R. Fry, of Ilfracombe. The total storage capacity at the works is now 400,000 cubic feet, which it is anticipated will be sufficient to meet the needs of the town for fifteen years.

Mr. J. P. Huxtable, the Chairman of the Ilfracombe Urban District Council, turned on the gas from the new holder to the town, and congratulated the Gas Company on their enterprise and progressive spirit. He thought the shareholders of the Company were fortunate in their selection of Directors. They were men of sound judgment, tact, and foresight, who stopped at nothing to ensure success. What he had said of the Directors he could equally say of the Manager (Mr. J. Armstrong). He also referred to the ability of the Secretary (Mr. A. Norman), and spoke in praise of the other officials. Ilfracombe was greatly indebted to the Gas Company for its development. He trusted that both the Gas Company and the Urban District Council would go on pursuing the same sound and progressive policy. Mr. R. Clogg, the Chairman of the Combe Martin Parish Council, also eulogized the Company; and Messrs. Raffarel and Tattam, two of the Directors, replied. Compliments were also paid to the Contractors.

THE FLOUR-MILL EXPLOSION IN GLASGOW.

Contact of Flour Dust with a Naked Light the Probable Cause.

The explosion which occurred in the flour-mill of Messrs. William Primrose and Sons, Centre Street, Glasgow, on the 10th ult., by which five persons lost their lives [*ante*, p. 480], was the subject of an inquiry held on Monday last week, in the County Buildings, before Sheriff Scott-Moncrieff and a Jury, under the Fatal Accidents Inquiry (Scotland) Act.

Among the first witnesses examined was Mr. W. S. Smith, His Majesty's Inspector for Dangerous Trades, who read a long report

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dealing with various aspects of the explosion and its probable cause. He stated that, in his opinion, the centre of the explosion was the first floor of the provender mill, at or near Nos. 2 and 3 pairs of millstones; this being the only portion of the machinery, with the exception of the adjacent pairs of stones, which showed any signs of damage. Apart from the collapse of the front wall, the rest of the mill showed only signs of slight scorching, due to the flash of a sudden flame. The boiler-house, engine-house, and "smut-house" (wheat-cleaning plant) were lighted by incandescent electric lamps; and the provender mill and the warehouse by gas-burners. There was, however, no evidence of leakage of gas; and the theory that the accident was due to a gas explosion might at once be dismissed. The only other explanation was the theory of a dust explosion; and the circumstances pointed to ignition of dust—possibly by a spark, but more probably by a naked light. The first floor was lighted by two naked gas-jets with fishtail burners—one from a short bracket near the centre of the north wall, and the other from a pendant bracket near the doorway leading into the provender warehouse. No signs of initial explosion were visible near these brackets; and, in his opinion, the explosion could not be attributed to the use of either of the naked lights. In addition to these gas-jets, a second bracket on the north wall some feet nearer the back of the room was fitted with a length of rubber tubing and a bunsen burner. He was informed that this burner was used to give light to the millers when dressing the millstones; the rubber tubing being of sufficient length to enable the burner to be placed on any of the millstones. When the burner was not required, it was placed on a small bracket near the wheaten millstones. Taking into consideration the whole of the circumstances, he had come to the conclusion that the explosion originated at the bunsen burner; that it was most probably due to a fall of meal dust from an overhead beam on to the luminous flame of the burner; that deposits and accumulations of meal dust were present in the mill, and probably in the warehouse: and that the presence of this disturbed dust in the atmosphere of the rooms was responsible for the transmission of the explosion through the entire warehouse.

The Jury returned a verdict to the effect that the several victims lost their lives through an explosion probably caused by flour dust coming in contact with a naked light or flame somewhere in the premises.

OVER-PAYMENT OF WATER CHARGES IN LONDON.

Criticism of the Metropolitan Water Board.

A conference of representatives of the Metropolitan, City, and Borough Councils, and other constituent authorities represented on the Metropolitan Water Board, sitting at the Westminster City Hall last Friday afternoon, considered "the practice of the Metropolitan Water Board in the matter of over-payments of water charges received from customers in mistake, with a view to obtaining concerted action on the part of representatives on the Board in order that the existing inequitable practice may be discontinued and the over-payments refunded to customers." Forty-two of the local authorities of Inner and Greater London were represented. The Mayor of Hammersmith (Mr. F. Mayle) was voted to the chair.

Mr. J. B. Mulholland, the representative of Hammersmith on the Water Board, said the matters under notice only came before the Board by way of report; and as details were not usually given, there was some excuse for members not knowing exactly what was going on. Having without avail drawn the attention of the Board to the questionable honesty of the practice, the only course open to him was to explain the position to his Borough Council, and, in effect, to place his resignation in their hands. The Council approved of his action, and, as a result, the present conference was called. Having quoted specific cases in support of his argument, the speaker said his action was taken quite apart from the decision of his Honour Judge Parry at the Lambeth County Court last July. [See "JOURNAL," Vol. CXV., p. 245.] The over-payments seriously affected small people, who were unable to fight the magnificently organized legal department of the Board, who were not popular owing to a persistent and long-continued system of pinpricks and petty injustice, the putting right of which would affect the financial position only very slightly, but would benefit thousands of small people, who deserved consideration. The conference were acting in the interests of the Board, and especially in those of public morality; and they were doing a duty in the interests of common honesty, fairness, and right.

Lieut.-Col. Davies moved the following resolution: "That this conference views with grave dissatisfaction the practice of the Board in refusing to refund for more than one year over-payments from consumers in mistake. That, in the opinion of this conference, refund should be made in such cases up to a period of not less than three years from the last quarter-day; and that the practice of pleading the Public Authorities Protection Act by way of defence to such claims is to be strongly deprecated"

After some remarks, the motion was carried *nem. con.*

Position of the Bradford Water Supply.—On the minutes of the Water Committee coming up for consideration at the meeting of the Bradford Corporation last Tuesday, Alderman Gadie, in reply to written questions, said the citizens had been on a curtailed water supply from Aug. 29 to Nov. 13. The reason Leeds did not suffer from shortage was because it had more storage capacity than Bradford. Bradford, however, supplied more people than Leeds; it was practically responsible for the water supply for a population of half-a-million. The Corporation now had 1514 million gallons of water stored, against 1700 million gallons at the corresponding date in 1910. They had an extra storage of 543⅓ million gallons in the month, and hoped before long to be in a much better position than last year.

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NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

As will be seen in another part of the "JOURNAL," Sheriff Substitute Moffatt has issued his decision in the prosecution, at the instance of the Falkirk Town Council, against Bailie Henry Russell, proprietor of the Crown Brass-Works, Falkirk. The charge against him was that he fraudulently employed for lighting purposes (the charge for which was 2s. 9d. per 1000 cubic feet) gas supplied to him by meter for power purposes at 2s. 4d. per 1000 cubic feet. The Sheriff Substitute was of opinion that the charge was not simply one of having made an improper connection, or a connection not authorized by the Statutes or by the town, but of making such a connection and using the gas "fraudulently." He had come to the conclusion that there was no fraud or fraudulent intention on the part of the defender. In 1910, Mr. Russell made large extensions and alterations of his works. He submitted, in the first place, that he was doing as he had all along done; and that the use he was making of gas in his electro-plating room was incidental to the use of the power, and necessary for its exercise. He considered also that he was giving compensation to the Corporation for any lighting use he was making of this gas by employing gas for stoves at lighting rates. Finally, he regarded the whole matter as so trifling as not to be worth serious attention. He had some justification for his opinion on the first point. It was not unnatural for a consumer of gas to assume that one gas-jet taken off the power supply at a place where there was no lighting supply close at hand was quite fair. That this was the view of other people also was shown by the fact that the Corporation themselves did the same thing, and had done the same thing for years, in the Burgh Stables, and that in the bill-posting establishment of the "Falkirk Herald" a similar connection was made. On the question of the gas alleged to have been fraudulently used, Mr. Wilson, the Gas Manager, stated that the number of lighting hours was 324, which made a consumption of 3888 cubic feet. The difference between the power rate and the lighting rate was 1s. 7d.; so that, upon the complainers' own figures, and on their case as originally conceived, the loss sustained by the Corporation if the computation made by Mr. Wilson lasted for one year, amounted to 1s. 7d. But the complainers' case was now reduced to one burner, which represented a sum of 6½d. Moreover, the alleged improper connection did not last a year. On Mr. Wilson's figures, the loss to the Corporation was approximately 2½d. Mr. Russell pays a gas account annually of about £100. Was it conceivable that a man paying regularly such an account, a man who was in a large way of business and a Magistrate of the borough, could be so foolish, to put it on no other ground, as to conceive a scheme and lay a plot to defraud the borough of a sum of money which was computed at 6½d. a year? He had no hesitation in saying that the triviality of the matter in dispute was a vital element in determining the guilt or innocence of the accused. In respect of all these reasons, without any hesitation, and with no doubt whatever, he found the accused clearly not guilty and entitled to expenses. The decision is by no means a strong one. I do not know that triviality can be taken account of while a Judge is making up his mind as to whether there has or has not been an offence. In mitigation of punishment, it is a quite competent consideration. Neither has a Judge any right to take into account that other people may be doing the same thing as the accused. It was no justification for Bailie Russell taking gas as he did that the Corporation were doing the same. The Corporation do not pay for the gas they consume; and therefore it matters little where they take it. It is quite open, generally speaking, for a head of a department to give and take a little. But there is a risk in doing it; and the safest course is not to do it. Even if an official should strain the situation so as to avoid finding the accused's action wrongful, his action would be very different from that of a Judge who admitted that the thing complained of was done, but that it was too trivial to form an offence.

On Monday, at the Dunfermline Town Council, the Convener of the Gas Committee drew the attention of the Council to the inadequacy of the premises occupied as show-room, workroom, and store in Maygate. The Gas Committee had fully discussed the matter, and had asked the Convener and the Dean of Guild to make inquiries as to obtaining more suitable accommodation. Applications were made by the third and fourth stokers in the gas-works for an increase of wages from 4s. 4d. to 4s. 8d. per shift. The applications were granted.

The annual municipal election in Peterhead took place on Tuesday. It will have been gathered from these "Notes" of late that the principal object of discussion has been whether or not communications relating to irregularities at the Corporation gas-works should or should not have been published. Bailie Birnie, the Convener of the Gas Committee, stoutly refused to publish these documents until it should be seen what the Secretary for Scotland would do in the matter. His attitude had, as might have been expected, the effect of engendering opposition to his candidature; and when the votes were counted on Tuesday evening, it was found that Bailie Birnie was at the bottom of the poll. All the new members elected at this time are opposed to the policy of the late Convener.

Sheriff Substitute Neish, in the Dundee Sheriff Court, on Monday had before him John Rose, who was charged with, and admitted, having stolen 1s. 6d. from a prepayment gas-meter in his house in Kidd Street. The padlock of the meter was handed to Sheriff Neish, who said it was one of the flimsiest things he had ever seen. The meter was not put into the house to be broken open, but to be a benefit to the user. He dismissed Rose with an admonition.

In the Arbroath Town Council on Monday, the Gas Committee's minutes contained a report by the Manager—Mr. A. C. Young—to the effect that 49 gas-fires and heating apparatus had been fixed for consumers this season, and that 25 are on order and would be fixed as soon as possible. All the fires ordered at the recent exhibition had been sold outright. A draft of the Provisional Order which the

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Corporation are promoting was submitted by the Clerk. The total borrowing powers sought is stated at £15,000. It was agreed that, from the commencement of the Order, the annual contribution to the sinking fund for the redemption of annuities and of borrowed money should be £630; and that the sum to be set apart as a sinking fund for the redemption of borrowed money under the present Order should be not less than 2 per cent. per annum on the amount borrowed for the time being. The draft Order was then approved; and it was agreed to submit it formally to the Council.

The Corporation of Johnstone are proceeding with great caution in the matter of extending the gas-works. The Council are in the course of negotiating for loans to enable them, among other things, to make the extensions.

At the request of the Parliamentary Bills Committee of the Middle Ward of Lanarkshire, a meeting held between them and the Gas Sub-Committee of the Hamilton Town Council discussed the subject of supplying Blantyre with gas. It was explained to the Committee that the Town Council were prepared to favourably entertain the proposal. The County Council Committee said they would carefully consider the explanations which had been made to them.

CURRENT SALES OF GAS PRODUCTS.

[For Table of "Tar Products Prices," see p. 858.]

LIVERPOOL, *Dec.* 16.

Sulphate of Ammonia.

There is no new feature to comment upon this week in the market for this article, the position having remained of rather an uninteresting nature. Fresh business has not been much in evidence; but the requirements to cover former sales for December shipment have been large enough to absorb the current production. The nearest closing values are still £14 2s. 6d. per ton f.o.b. Hull, £14 3s. 9d. per ton f.o.b. Liverpool, and £14 6s. 3d. per ton f.o.b. Leith. For future delivery, producers persist in demanding a premium on spot prices, but it has not been recorded that they have succeeded in making new contracts. Second-hand sellers are reported to be less conservative in their views, and to have taken orders for delivery during the first half of next year at approximately prompt figures.

Nitrate of Soda.

There is still no change to report in this commodity for near delivery, and holders continue firm at 10s. 1½d. per cwt. for ordinary and 10s. 4½d. for refined quality.

LONDON, *Dec.* 18.

Tar Products.

The markets for tar products remain very firm. Pitch is in good demand, and maintains its price. Benzols are steady, though in some quarters slightly lower prices have been accepted. Crude carbolic is very strong; and there has been considerable excitement in the market for this article during the past few days. Creosote is in good demand, and prices remain very firm.

The average values during the week were: Tar, 22s. 9d. to 26s. 9d. *ex* works. Pitch, London, 41s. 6d. to 42s. 6d.; east coast, 41s. 6d. to 42s.; west coast, Clyde 40s. 6d. to 41s. 6d., Manchester 40s. 6d. to 41s., Liverpool 41s. 6d. to 42s. Benzol, 90 per cent., naked, London 11d.; North, 10¾d.; 50-90 per cent., naked, London, 10d. to 10¼d.; North, 9¾d. Toluol, naked, London, 10d.; North, 8¼d. to 9d. Crude naphtha, in bulk, London, 4½d. to 5d.; North, 3¾d. to 4¼d. Solvent naphtha, naked, London, 10¼d. to 10½d. f.o.b.; North, 9¼d. to 9⅜d. f.o.b. Heavy naphtha, naked, London, 11½d. to 1s. 0¼d. f.o.b.; North, 10d. to 10¼d. f.o.b. Creosote, in bulk, London, 2⅞d. to 3⅛d.; North, 2¾d. to 2⅞d., salty; 2⅝d. to 2¾d., liquid. Heavy oils, in bulk, 3⅛d. to 3¼d. Carbolic acid, casks included, 60 per cent., east coast, 2s. 10d. to 3s.; west coast, 2s. 11d. Naphthalene, £4 10s. to £9; salts, 40s. to 45s., bags included. Anthracene, "A" quality, 1½d. to 2d. per unit, packages included and delivered.

Sulphate of Ammonia.

There has been very little buying during the past week; but prices have remained practically unaltered. Actual Beckton is still quoted at £13 17s. 6d. Outside London makes are £13 7s. 6d.; Hull, £14 2s. 6d.; Liverpool, £14 3s. 9d. to £14 5s.; Leith, £14 5s. to £14 6s. 3d.; Middlesbrough, £14 2s. 6d.

COAL TRADE REPORTS.

Northern Coal Trade.

The demand for coals is strong; but some difficulty is felt in arranging for the loading of steamers, as there is little fuel free for sale for the rest of the year. Best Northumbrian steams are quoted 12s. per ton f.o.b., second-class steams from 11s. to 11s. 3d., and steam smalls from 5s. 6d. to 6s. 6d. The production is heavy, as is usual just before the great holidays; and it is fully taken up. In the gas coal trade, this is the season of the largest consumption, and the demand is consequently at its strongest, with high prices for any lots that are available. Durham gas coals are quoted at about 11s. 6d. per ton for second-class kinds. Best Durhams are about 12s. 9d. per ton f.o.b.; and "Wear specials" are from 13s. to 13s. 3d. There have been sales of some 50,000 tons of good second-class gas coal for delivery over next year at Genoa at about 18s. 3d. per ton, which shows some improvement over the recently-ruling prices for such sales, though the cost of the sea freight is much higher. Coke is firm. Gas coke is in heavy production; but the output is well taken up, and good makes command from 14s. to 15s. per ton f.o.b. in the Tyne.

Scotch Coal Trade.

There is no appearance of any slackening in the demand for all classes of coal; nor is there much appearance of prices going very far

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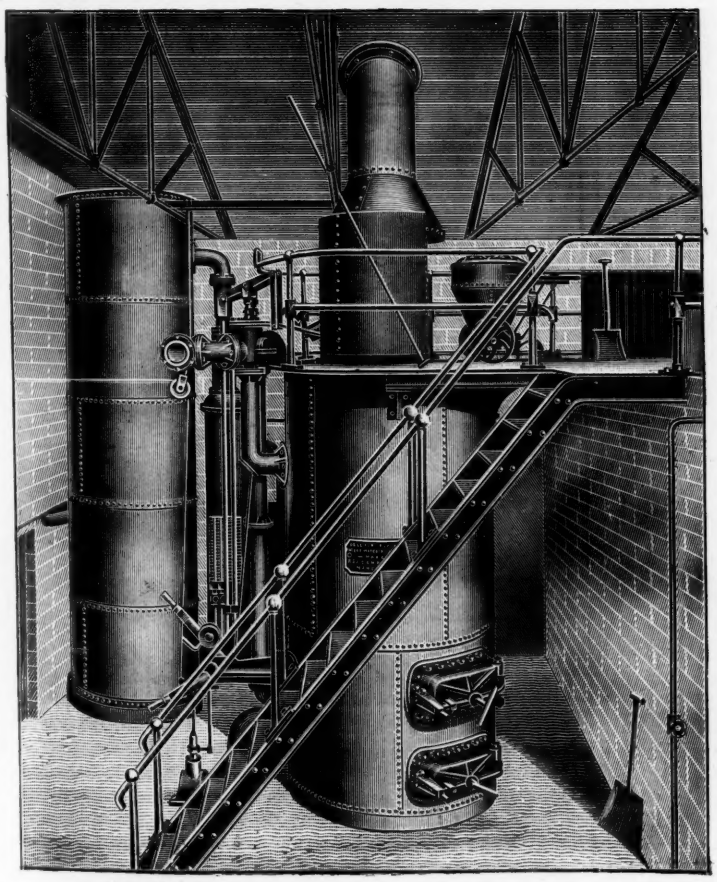

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up. The most that can be said about prices is that they are firm. The quotations are: Ell, 11s. 3d. to 12s. per ton f.o.b. Glasgow; splint, 11s. 9d. to 12s.; steam, 10s. 3d. to 10s. 6d. The shipments for the week amounted to 343,505 tons—an increase on the previous week of 3796 tons, and on the corresponding week of 27,951 tons. For the year to date, the total shipments have amounted to 15,685,499 tons—an increase on the corresponding period of 380,537 tons.

Sales of Stocks and Shares.

At the Mart, Tokenhouse Yard, E.C., last Tuesday, Messrs. A. & W. Richards placed two new issues of capital by order of Directors, and sold stocks and shares under instructions from Executors and other owners. An issue of £5000 of 5 per cent. preference stock of the North Middlesex Gas Company was disposed of at £112 to £112 10s. per £100; and another of £10 preference shares in the South Kent Water Company at par. A parcel of consolidated ordinary stock of the Aylesbury Gas Company, carrying 5 per cent. dividend, was sold at the rate of £96 per £100. A few £10 fully-paid "B" shares in the Grays and Tilbury Gas Company, ranking for a standard dividend of 7 per cent., subject to the sliding-scale, and carrying £5 19s. per cent., fetched £11 12s. 6d. each. The final lots consisted of £1000 of "B" stock of the Eastbourne Gas Company, ranking for 3½ per cent. dividend, but at present receiving £6 5s. per cent.; and it fetched £138 per £100. Last Thursday, Mr. George Nichols (Messrs. Nichols, Young, Hunt, Alder, and Co.) offered for sale £15,000 of general capital stock and £5000 of new debenture stock of the Bristol Gas Company. The former was disposed of at £113 15s. to £114, and the latter at £100 15s. to £101, per £100 of stock. The total sum realized for the general stock was £17,065 15s., or an average of £113 15s. 5d. per £100; and for the debenture stock £5041 15s., or an average of £100 16s. 8d. Some £50 "C" shares in the Portsea Island Gas Company recently realized £128 and £129 each; and some £5 shares (1883) in the Portsmouth Water Company fetched from £8 17s. 6d. to £8 19s. per share. At a sale last Wednesday, 101 new ordinary £10 shares in the Slough Gas Company realized from £16 7s. 6d. to £16 12s. 6d. apiece. The last dividend paid on the shares was at the rate of £8 1s. per cent. per annum.

Chapel and Whaley Bridge Gas Company.—Mr. Tom Wright, of Matlock, the Chairman of this Company, presided at a general meeting of the shareholders recently held at Chinley, when a dividend at the rate of 3 per cent. was declared on the first year's working, some particulars in regard to which were given in the "JOURNAL" last week (p. 785). It was stated that with the recent issue the capital of the Company was £45,000, and the success of the concern was assured.

Belfast Corporation Bill Royal Assented.—In the House of Lords last Saturday, a number of Bills received the Royal Assent by Commission, on the prorogation of Parliament. One of them was the Belfast Corporation Bill, which contains a clause conferring power upon the Corporation with respect to the prices to be charged for gas, and enabling them to fix a lower rate for that used for power and manufacturing purposes. The progress of the Bill was indicated in the "JOURNAL" for the 28th ult. (p. 624).

Electric Light Failure during a Trial.—During the hearing of an insurance case at the Burnley County Court last Thursday evening, the electric light failed, and the building was plunged in darkness. After a time, one of the Court officials appeared with a lighted candle, and it was placed beside the Judge. Later more candles were produced, and served out to the Jury, the members of the Bar, and the reporters. When the Jury left the box to deliberate on their verdict, they were preceded by a Court official holding aloft a lighted candle.

Schweder v. Worthing Gas Company.—This case, which was tried by Mr. Justice Eve at the close of October [see *ante*, p. 399], was before him again on Monday last week, on a motion in connection with a new action by the plaintiff. His Lordship said he did not want to put either side to the expense of a double trial; and he would not hear the matter on a motion if it was one that must go to trial. He thought he could fix the 16th of January for it. If the defendants would undertake to preserve the *status quo*, the operation of the former judgment would be suspended.

Lecture on "Gas Heating-Stoves."—A series of lectures and practical demonstrations for the benefit and assistance of the members of their outdoor staff have been arranged by the Directors of the Southampton Gas Company. The first was given last Tuesday by Mr. G. D. Glasscoe, of Messrs. Fletcher, Russell, and Co., Limited, on "Gas Heating-Stoves, their Fitting and Fixing." The lecturer dealt in a comprehensive manner with the right selection of a fire, the proper flow and pressure of gas required, governed and ungoverned services, the variations of draught to be met with in chimneys, how to remedy excessive up-draughts or prevent down-draughts, fires past and present, when flueless fires or radiators should not be used, adjustment of burners according to local conditions, and the proper cleaning of burners. Demonstrations were given illustrating the various points mentioned; and at the conclusion the lecturer was warmly thanked for the practical way in which he had dealt with his subject.

Skegness Water Scheme.—At the offices of the Skegness Urban District Council last Tuesday, Mr. R. H. Bicknell, one of the Inspectors of the Local Government Board, held an inquiry into an application made by the Skegness Urban District Council for sanction to borrow £1000 for the purposes of their water undertaking. Mr. T. E. Maynard-Page, the Clerk to the Council, said that of the amount applied for £306 had already been expended on mains and fittings, and had been paid out of revenue. After deducting the cost of hydrants and adding 10 per cent. for contingencies, the cost of the new mains amounted to £509. This left a balance of £185 for future mains required during the next three years, together with fittings and meters to old and new mains, which would not be sufficient to meet capital expenditure. The Inspector said it was quite evident that the amount would not be enough; and he suggested that the Council should immediately call a meeting to pass a resolution for sanction to borrow a further £300 or £500.

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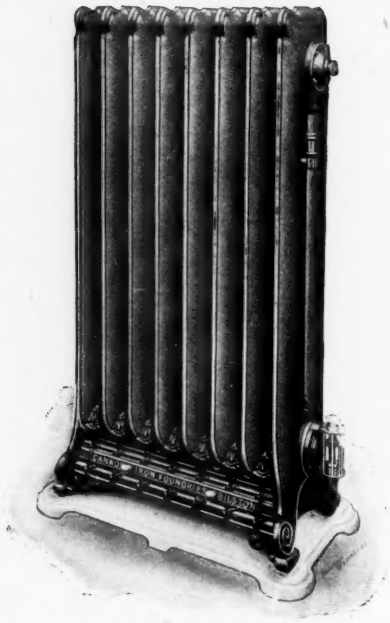

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DEEPFIELDS, Nr. Bilston, Staffs., Eng.

London Office and Show-Rooms:—

18, HOLBORN VIADUCT, E.C.

New Water Scheme for Nantwich.—Tenders have been placed by the Nantwich Urban District Council for their scheme of water supply at Madeley. The first portion, which has already been taken in hand, is the sinking of a well and borehole; the Contractors being Messrs. Castle and Co., of Margate and Rhyl. The second instalment will be proceeded with, provided the water obtained is satisfactory in quantity and quality. It will consist of a service reservoir at a high elevation, to which the supply from the well will be pumped; and it is intended to convey it thence to Nantwich—a distance of about ten miles—by a 9-inch cast-iron main. Mr. W. F. Newey, the Engineer and Surveyor to the Council, is the Engineer for the scheme.

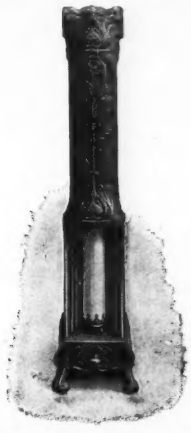
The Fatal Oil-Mill Explosion at Liverpool.—In the course of the inquiry into the cause of the recent fatal explosion at the oil-mills of Messrs. Bibby at Liverpool, the Chief Engineer (Mr. Ernest Evans) related how matches had been found in the workmen's clothing, and one match, not ignited, behind a dynamo concealed between a pair of magnet bobbins, presumably to enable someone to have a smoke who did not wish to be found with a match upon him if searched. There were three jets of gas in the cellar where the explosion occurred; but witness said he was sure the gas was turned off at the time. His theory of the cause of the explosion was that the blowing of an electric fuse started one slight explosion, and that then the belting of a machine broke in two, causing a great disturbance of dust, which, combined with the first explosion, brought about the catastrophe.

Finances of the Metropolitan Water Board.—At the meeting of the Metropolitan Water Board last Friday, the report presented by the Finance Committee showed that the amount written off on account of empties for the past half year was £65,190, or 5·52 per cent. For the six months to March 31, the amount and percentage equalled £66,692, or 5·73, and for the half year to Sept. 30, 1910, £71,319, or 5·97 per cent. The diminution of the allowances for empty premises was regarded by the Committee as a very satisfactory feature, and appeared to confirm the hope expressed in the previous report that the turning-point had been reached in the period of depression in this respect through which the Metropolis had been passing during the last few years. The amount of arrears outstanding at Sept. 30 last, in respect of domestic supplies and fixed charges was £37,479, compared with £38,408 at Sept. 30, 1910, and £32,625 at March 31 last. During the half year under review, the new quinquennial valuation of the Metropolis came into operation. The Committee said this had usually had the effect of retarding the collection, and consequently increasing the arrears outstanding at the end of the six months. A comparison of the result of this half year with that of the corresponding period at the previous quinquennial valuation—viz., September, 1906—showed that the arrears of domestic and fixed charges five years ago amounted to £61,692, or 5·58 per cent., against the £37,479, or 3·17 per cent., for the half year just closed. The report was adopted.

APPLICATIONS FOR LETTERS PATENT.

27,005.—Barbet, E. A., "Distillation of tar." Dec. 2.
27,018.—Zillmer, M., "Pressure-gauges." Dec. 2.
27,054.—Wood, E. E., and Hollings, J. S., "Purification of waste liquors." Dec. 4.
27,055.—Christie, G., "Gas-burning torch." Dec. 4.
27,065.—Parker, T. H., "Controlling the supply of gas." Dec. 4.
27,072.—Sumner, A. W., "Facilitating the action of a gas on a liquid, or *vice versâ*." Dec. 4.
27,125.—Waller, A. S., "Gas-burners and cocks." Dec. 4.
27,129.—Picot, G. F., "Safety devices for gas apparatus." Dec. 4.
27,158.—Burns, E. J., "Regulating the pressure of gas." Dec. 4.
27,165.—Aldridge, J. G. W., "Charging-machines." Dec. 4.
27,207.—Chamberlain, G. R., and Schroeder, A. G., "Gas-fixtures." Dec. 5.
27,214-5.—Yates, H. J., and Forshaw, A., "Thermostats." Dec. 5.
27,223.—Evans-Cross, G. W., "Water-meters." Dec. 5.
27,281.—Philip, A., and Steele, L. J., "Detectors of combustible gases." Dec. 5.
27,285.—Carpenter, A., "Combined cooker and heater." Dec. 5.
27,298.—Pelsmaekers, A., "Gas-stoves." Dec. 5.
27,302.—Wellington, S. N., and Schuster, N., "Bunsen burners." Dec. 6.
27,313.—Lewis, G. P., "Mantles." Dec. 6.
27,324.—Luff, A. W., "Anti-vibrator." Dec. 6.
27,332.—Mann, J., "Gas-flash boiler-heater." Dec. 6.
27,354.—Zdanowich, J. O., "Mantles." Dec. 6.
27,357.—Hartung, C. A., "Measuring steam, gas, or liquid." Dec. 6.
27,358.—Sparks, E., "Mantles and supports." Dec. 6.
27,467.—Liese, H. M., "Measuring gases and liquids." Dec. 7.
27,484.—Simmance, J. F., and Abady, J., "Apparatus for, and actuated by, gases of varying density." Dec. 7.
27,497.—Agnew, W., "Illuminating and heating apparatus." Dec. 7.
27,513.—Ostorog, S. J., "Distance gas lighting." Dec. 7.
27,514.—Thiem, W., "Remote-controlled gas-igniters." Dec. 7.
27,533-4-5.—Bone, W. A., and M'Court, C. D., "Gasification and combustion of liquid fuel." Dec. 8.
27,546-7.—Hoeller, W., "Gas-generators." Dec. 8.
27,563.—Parsons, R., "Extinguishers or regulators for gas-lamps." Dec. 8.
27,582.—Berry, J., Glover, W. T., and Meters Limited, "Retort-house governors." Dec. 8.
27,612.—Southey, A. W., "Production of gaseous fuel." Dec. 8.
27,624.—Koppers, H., "Delivery of coke." Dec. 8.
27,636.—Garner, F. W., "Joints for pipes." Dec. 9.
27,642.—Langford, P. N., and Shilton, W. A., "Fastenings for retort mouthpieces." Dec. 9.
27,687.—Sakai, Y., "Stop-cocks." Dec. 9.
27,688.—Hart-Bayes, R. J., "Gas-generators." Dec. 9.
27,696.—Theisen, H. E., "Apparatus for purifying, cooling, and washing gases." Dec. 9.

GAS FIRES and RADIATORS
for HIRING PURPOSES.



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LOW COST.

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WARRINGTON, MANCHESTER, & LONDON.

Charge for Water by Meter in Liverpool.—With the object of encouraging the establishment of new industries in the district, the Liverpool Corporation Water Committee, at their meeting last Tuesday, directed the Town Clerk, Water Engineer, and City Treasurer to prepare a report as to the possibility of supplying water by meter for trade purposes and shipping at lower rates than those now charged. The following motion, as an addendum to the resolution involving this decision, was also agreed to: "That for the future this Committee will be prepared to quote terms for the supply of water for industrial purposes based on the requirements of the new applicants, with a minimum charge of 4d. per 1000 gallons; also, in existing accounts of £25 per annum and upwards, where the customer is prepared to guarantee a payment equal to a normal year's consumption on the present rating, such consumer shall be given the option of a supply at 4d. per 1000 gallons." This resolution will be considered by the officials in formulating their report.

At a special sitting of the Warwick Bankruptcy Court last Thursday, the public examination of Mr. E. R. Terry was resumed. A large portion of the proceedings related to the debtor's connection with Alderman Flavel and the Imperial Stove Company, of Leamington; and the examination was brought to a close, subject to a deficiency account being filed on the assumption that the Alderman's claim on the estate (amounting to £8000) holds good.

Tenders submitted by Messrs. Underwood and Brother, of Dukinfield, for the construction of a large dam and reservoir and other works for £158,873, and for laying 25 miles of main, and constructing a tunnel, two service reservoirs, &c., for £102,872, have been accepted by the Abertillery Water Board.

At the annual general meeting of Messrs. James Milne and Son, Limited, on Thursday, the Directors will report a debit balance of £2330. In addition, depreciation on plant, machinery, and buildings to the extent of £1149, has to be charged; thus leaving a debit of £3479. Adding the sum brought forward, £5630, the total standing at the debit of profit and loss is £9109. The Directors state that the stocks of each branch and head-quarters have been minutely examined by the General Manager and themselves, and slow-moving articles fully depreciated.

By permission of the Gas Committee of the Southport Corporation, the "Junior Town Council" paid a visit of inspection to the gas-works on the 9th inst. They were received by the Gas Engineer (Mr. John Bond) and two of his assistants, who conducted the visitors in two parties round the works. The laboratory specially claimed the interest of the members, as they were there shown the apparatus used for gas-testing purposes. After spending two hours in going through the works, the parties met again at the offices, where Mr. Bond kindly entertained them at tea, at which the Chairman of the Gas Committee (Mr. E. Trounson, J.P.) was present. The thanks of the visitors were accorded to Mr. Bond and his assistants for their courtesy.

TAR PRODUCTS PRICES.

Representative manufacturers give the following as fair current values for the week ending Dec. 16. Prices are net, and they include the usual packages and delivery f.o.b., f.a.s., or f.o.r., as customary.

Article.	Basis.	London.	North-East Coast.	East Coast, Yorks.	West Coast.		Glasgow.
					Liverpool.	Manchester.	
Tar, crude	per ton	—	21/3 26/-	22/6 26/6	—	23/- 26/6	—
Pitch	"	42/6	41/-	41/-	40/6	40/3	40/-
Benzol, 90%	per gallon	1/2½	-/11¾	1/-	1/-	-/11½	1/-
Benzol, 50-90%	"	—	-/11½	-/11	-/11	-/10⅞	—
Toluol, 90%	"	—	-/11 -/11⅛	-/11	—	-/10¼	-/11
Crude naphtha, 30%	"	—	-/4⅞	-/4¾	-/5	-/4⅞	—
Light oil, 50%	"	—	-/3⅞	-/3¾	-/4¾	-/4⅝	—
Solvent naphtha, 90-160	"	—	-/10½	-/10½	—	-/10¾	-/11½
Heavy naphtha, 90-190	"	—	-/10⅝	-/11	—	-/11¼	-/11¼
Creosote in bulk	"	-/3½	-/2⅝	-/2 9/16	-/2⅝	-/2⅝	-/2 3/16
Heavy oils	"	—	-/2⅝	-/2½	—	-/2⅞	-/2 11/16
Carbolic acid, 60's	"	—	2/9	2/10	2/6	2/6	2/6
Naphthalene, crude drained salts	per ton	—	44/6	42/6	47/6	50/-	—
" pressed	"	—	61/6	63/-	60/-	60/- 75/-	—
" whizzed	"	—	—	—	70/- 72/6	65/- 75/-	62/6
Anthracene	per unit	-/1⅞ -/2	-/1½	-/1½	-/1¼	-/1¼	—

GAS COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 813.

Issue.	Share	When Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
1,551,868	Stk.	Oct. 12	5	Alliance & Dublin Ord.	79—82	..	6 1 11
374,000	Stk.	July 14	4	Do. 4 p.c. Deb.	93—95	..	4 4 3
250,000	5	Sept. 28	7	Bombay, Ltd.	6—6¾	..	5 7 8
50,000	10	Aug. 31	15	Bourne-) 10 p.c.	29—33	..	5 0 0
311,810	10	"	7	mouth Gas) B 7 p.c.	16½—16¾	..	4 3 7
75,000	10	"	6	and Water) Pref. 6 p.c.	14½—14¾	..	4 1 4
380,000	Stk.	Aug. 16	13	Brentford Consolidated	256—261	..	4 19 7
330,000	"	"	10	Do. New	198—203	..	4 18 6
50,000	"	"	5	Do. 5 p.c. Pref.	120—122	..	4 2 0
206,250	"	Dec. 14	4	Do. 4 p.c. Deb.	97—99*	+1	4 0 10
220,000	Stk.	Aug. 31	11	Brighton & Hove Orig.	217—222	..	4 19 1
246,320	"	"	8	Do. A Ord. Stk.	156—159	..	5 0 8
490,000	20	Sept. 28	12½	British	44¼—45½	..	5 9 11
120,000	Stk.	June 30	4	Do. 4 p.c. Deb. Stk.	94—96	..	4 3 4
109,000	"	Aug. 16	6	Bromley, A 5 p.c.	127—132	..	4 10 11
165,700	"	"	4½	Do. B 3½ p.c.	97—102	..	4 8 3
82,278	"	"	5½	Do. C 5 p.c.	117—122	..	4 10 2
55,000	"	June 30	3½	Do. 3½ p.c. Deb.	82—84	..	4 3 4
250,000	Stk.	"	4	Buenos Ayres 4 p.c. Deb.	96—98	..	4 1 8
100,000	10	—	—	Cape Town & Dis., Ltd.	2—3	..	—
100,000	10	—	—	Do. 4½ p.c. Pref.	4¼—5½	..	—
100,000	Stk.	June 30	4½	Do. 4½ p.c. Deb. Stk.	80—83	..	5 8 5
157,150	Stk.	Aug. 16	5	Chester 5 p.c. Ord.	111—113	..	4 8 6
1,513,280	Stk.	"	5/9/4	Commercial 4 p.c. Stk.	110—112	..	4 17 7
560,000	"	"	5¼	Do. 3½ p.c. do.	105—107	..	4 19 8
475,000	"	Dec. 14	3	Do. 3 p.c. Deb. Stk.	75—77*	+½	3 17 11
800,000	Stk.	"	4	Continental Union, Ltd.	86—90*	−½	4 8 11
200,000	"	"	7	Do. 7 p.c. Pref.	132—134*	+½	5 4 6
492,270	Stk.	—	5½	Derby Con. Stk.	122—124	..	4 8 9
55,003	"	—	4	Do. Deb. Stk.	104—105	..	3 16 2
840,150	10	July 28	10	European, Ltd.	20—21	+½	4 15 3
16,161,600	Stk.	Aug. 16	4/14/8	Gas-) 4 p.c. Ord.	104½—105½	..	4 9 9
2,600,000	"	"	3½	light) 3½ p.c. max.	84½—86½	..	4 0 11
4,062,235	"	"	4	and) 4 p.c. Con. Pref.	102—104	..	3 16 11
4,531,705	"	Dec. 14	3	Coke) 3 p.c. Con. Deb.	79—81*	+½	3 14 1
258,740	Stk.	Sept. 14	5	Hastings & St. L. 3½ p.c.	94—96	..	5 4 2
82,500	"	"	6½	Do. do. 5 p.c.	—	..	—
70,000	10	Oct. 12	11	Hongkong & China, Ltd.	17—17½	..	6 5 9
131,000	Stk.	Sept. 14	7½	Ilford A and C	154—157	..	4 15 6
65,780	"	"	6	Do. B	125—128	..	4 13 9
65,500	"	June 30	4	Do. 4 p.c. Deb.	94—96	..	4 3 4
4,940,000	Stk.	Nov. 10	9	Imperial Continental	188—190	+2	4 14 9
1,235,000	Stk.	Aug. 16	3⅓	Do. 3½ p.c. Deb. Red.	90—92	..	3 16 1

Issue.	Share.	When ex. Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.				£ s. d.
200,242	Stk.	Aug. 31	6	Lea Bridge Ord. 5 p.c.	125—130	..	4 12 4
561,000	Stk.	Aug. 16	10	Liverpool United A.	218—220	..	4 10 11
718,100	"	"	7	Do. B.	163—165	−1	4 4 10
306,083	"	June 30	4	Do. Deb. Stk.	102—104	..	3 16 11
75,000	5	Dec. 14	6	Malta & Mediterranean	4½—5*	..	6 0 0
560,000	100	Oct. 2	5	Met. of) 5 p.c. Deb.	100—102	..	4 18 0
250,000	100	"	4½	Melbourne) 4½ p.c. Deb.	100—102	..	4 8 3
541,920	20	Nov. 10	3½	Monte Video, Ltd.	12—12½	..	5 12 0
1,775,892	Stk.	July 28	4½	Newc'tle&G'tesh'd Con.	100½—101½	−½	4 6 2
529,705	Stk.	June 30	3½	Do. 3½ p.c. Deb.	87—89	..	3 18 8
55,940	10	Aug. 31	7/7/0	North Middlesex 7 p.c.	14½—15½	..	4 14 10
300,000	Stk.	Dec. 14	8	Oriental, Ltd.	134—136*	+½	5 17 8
60,000	5	Sept. 28	8	Ottoman, Ltd.	6¾—7¼	..	5 10 4
31,800	53	Aug. 16	13	Portsea Island A	140—145	..	4 14 10
60,000	50	"	13	Do. B	133—138	..	4 14 2
100,000	50	"	12	Do. C	130—135	..	4 8 11
398,490	5	Oct. 12	8	Primitiva Ord.	7⅞—7⅞	..	5 4 11
796,980	5	June 30	5	Do. 5 p.c. Pref.	5½—5⅝	..	4 13 0
488,900	100	Dec. 1	4	Do. 4 p.c. Deb.	97—99	..	4 0 10
312,650	Stk.	June 30	4	River Plate 4 p.c. Deb.	96—98	..	4 1 8
250,000	5	Sept. 28	12	San Paulo, Ltd.	10½—11	..	5 9 1
115,000	10	"	6	Do. 6 p.c. Pref.	11½—12	..	5 0 0
125,000	50	July 1	5	Do. 5 p.c. Deb.	50—51	..	4 18 0
135,000	Stk.	Aug. 31	10	Sheffield A	239—241	..	4 3 0
209,984	"	"	10	Do. B	239—241	..	4 3 0
523,500	"	"	10	Do. C	239—241	..	4 3 0
90,000	10	Sept. 28	6	South African	8—9	..	6 13 4
6,429,895	Stk.	Aug. 16	5/9/4	South Met., 4 p.c. Ord.	116—118	..	4 12 8
1,895,445	"	July 14	3	Do. 3 p.c. Deb.	79—81	..	3 14 1
209,820	Stk.	Aug. 16	8½	South Shields Con. Stk.	155—157	..	5 8 3
605,000	Stk.	"	5⅝	S'th Suburb'n Ord. 5 p.c.	121—123	..	4 12 0
60,000	"	"	5	Do. 5 p.c. Pref.	117—120	..	4 3 4
117,058	"	July 14	5	Do. 5 p.c. Deb. Stk.	121—123	..	4 1 4
502,310	Stk.	Nov. 10	5	Southampton Ord.	107—109	..	4 11 9
120,000	Stk.	Aug. 16	7½	Tottenham) A 5 p.c.	145—148	..	4 16 3
483,940	"	"	5⅝	and) B 3½ p.c.	115—117	..	4 16 1
149,470	"	June 15	4	Edmonton) 4 p.c. Deb.	96—98	..	4 1 8
182,380	10	June 15	5	Tuscan, Ltd.	8⅞—9½	..	5 8 1
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	96—98	..	5 2 0
236,476	Stk.	Aug. 16	5	Tynemouth, 5 p.c. max.	114—116	..	4 6 2
255,636	Stk.	Aug. 31	6¼	Wands-) B 3½ p.c.	142—145	..	4 14 10
85,766	"	June 30	3	worth) 3 p.c. Deb. Stk.	73—75	..	4 0 0

Prices marked * are "Ex. div."

The Vertical Gas-Retort Syndicate, Limited, intimate that a further order is to hand for Dessau verticals—namely, two furnaces, one with ten retorts, and the other with eight retorts, for the Olten (Switzerland) Gas-Works.

The Perth Town Council recently advertised for offers to supply electric capstans for railway shunting work at the Corporation gas-works; and at a recent meeting the offer was accepted for the supply of Liddle patent capstans.

WANTED, FOR SALE, CONTRACTS, &c., ADVERTISEMENTS IN THIS WEEK'S "JOURNAL."

Appointments Vacant.

REPRESENTATIVE. Parkinson Stove Company, Birmingham.
COLLECTOR-REPRESENTATIVE. Dorking Gas Company. Applications by Jan. 3.
MAN TO WORK BENZOL PLANT. No. 5497.

Appointments Wanted.

CHEMICAL PLUMBER, &c. No. 5492.
REPRESENTATIVE (Engineering Firm). No. 5493.

Plant, &c. (Second Hand), for Sale.

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RETORT BENCH IRONWORK. No. 5495.

Patent Licence, &c.

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Stocks and Shares for Sale.

GLOVER AND MAIN, LIMITED. No. 5496.

TENDERS FOR

Gasholder and Tank, &c.

NEWTOWNARDS GAS DEPARTMENT. Tenders by Jan. 18.

Tar.

HARWICH GAS AND COKE COMPANY. Tenders by Jan. 6.

NOTICES TO CORRESPONDENTS, ADVERTISERS, AND SUBSCRIBERS.

No notice can be taken of anonymous communications. Whatever is intended for insertion in the "JOURNAL" must be authenticated by the name and address of the writer; not necessarily for publication, but as a proof of good faith.

CHRISTMAS HOLIDAY.

In consequence of the CHRISTMAS HOLIDAYS, it will be a convenience if Communications for the next issue of the "JOURNAL" and Orders respecting ADVERTISEMENTS are received at the Office by 10 o'clock ON FRIDAY MORNING at latest.

Wanted, For Sale, and Tender Advertisements, Six Lines and under, 3s.; each additional Line, 6d.

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See Illustrated Advertisement, Dec. 5, p. 663.

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The Council do not bind themselves to accept the lowest or any Tender.
Tenders, marked "Gasholder," to be addressed to me, and will be received up to Twelve o'clock Noon on Thursday, the 18th day of January, 1912.

H. M'Cartney,
Clerk to the Council.

Town Hall, Newtownards,
Dec. 16, 1911.

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The Tar will be Delivered free into Railway Tank Waggons or Tank Barges at the Works.
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Sealed Tenders to be Delivered addressed to me not later than the 6th day of January, 1912.

Geo. Baines,
Secretary and General Manager.

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MESSRS. A. & W. RICHARDS beg to notify that their SALES BY AUCTION of NEW CAPITAL ISSUED UNDER PARLIAMENTARY POWERS, and of STOCKS and SHARES belonging to EXECUTORS and other PRIVATE OWNERS in LONDON, SUBURBAN, and PROVINCIAL GAS and WATER COMPANIES, take place PERIODICALLY at the Mart, TOKENHOUSE YARD, E.C.
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By order of the Board,
Ernest W. Drew,
Secretary.

THE Owner of British Patent No. 138, of 1908, entitled "IMPROVEMENTS IN DISTILLING AND COKING COAL" granted to Samuel Bertram Sheldon, is desirous of DISPOSING of the Patent or entering into a WORKING ARRANGEMENT under LICENSE with Firms likely to be interested in the same. In the Alternative the Owner would be open to Consider Proposals to Manufacture the Apparatus and to carry out the Process to fill any requirements of the Market in Great Britain on Terms to be arranged. The Patent covers an Invention interesting to Manufacturers of Gas and Coke and Gas Producers. Detailed Information as to the Invention will be found in the Patent Specification of which a copy will be supplied to any interested party on request.
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